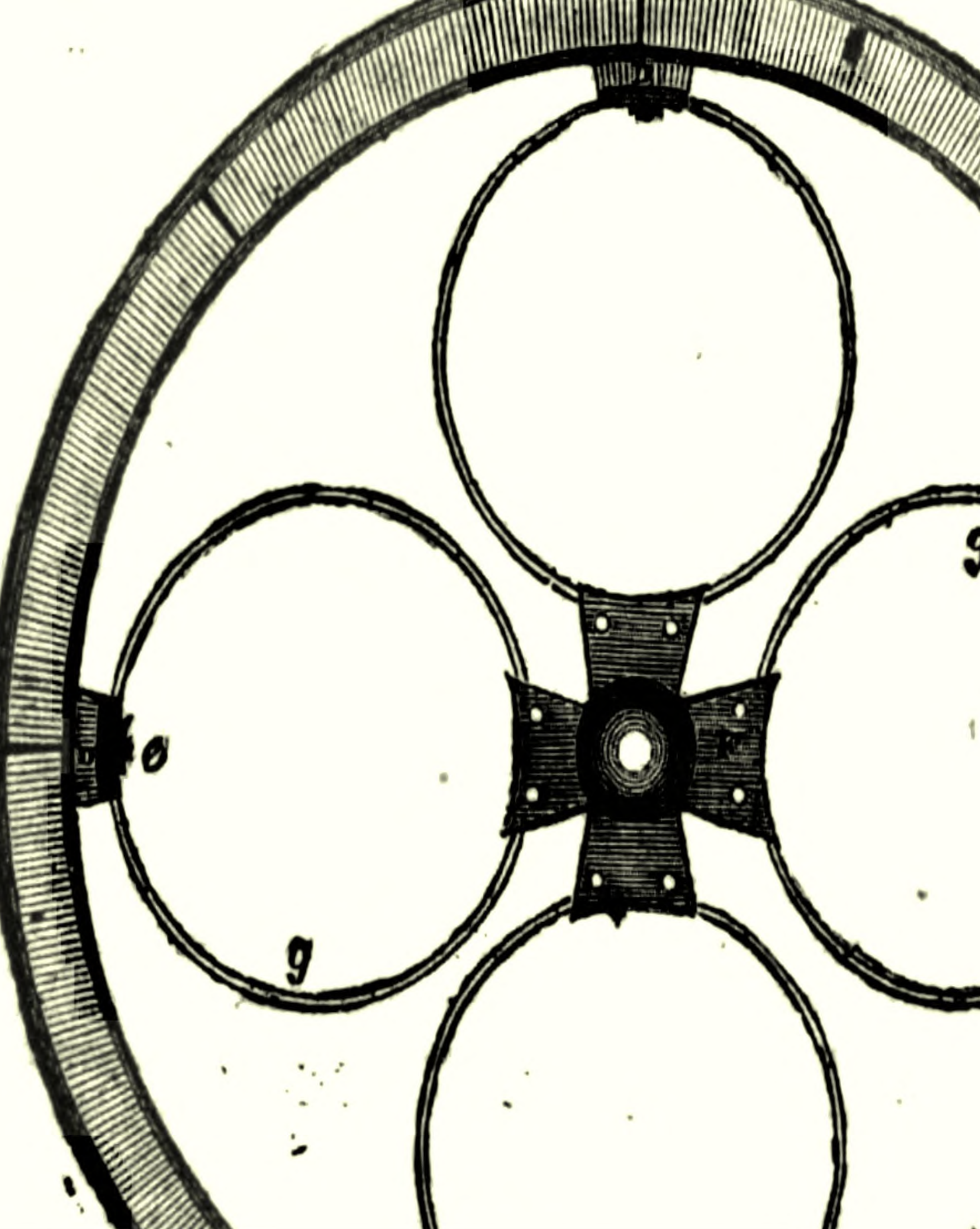
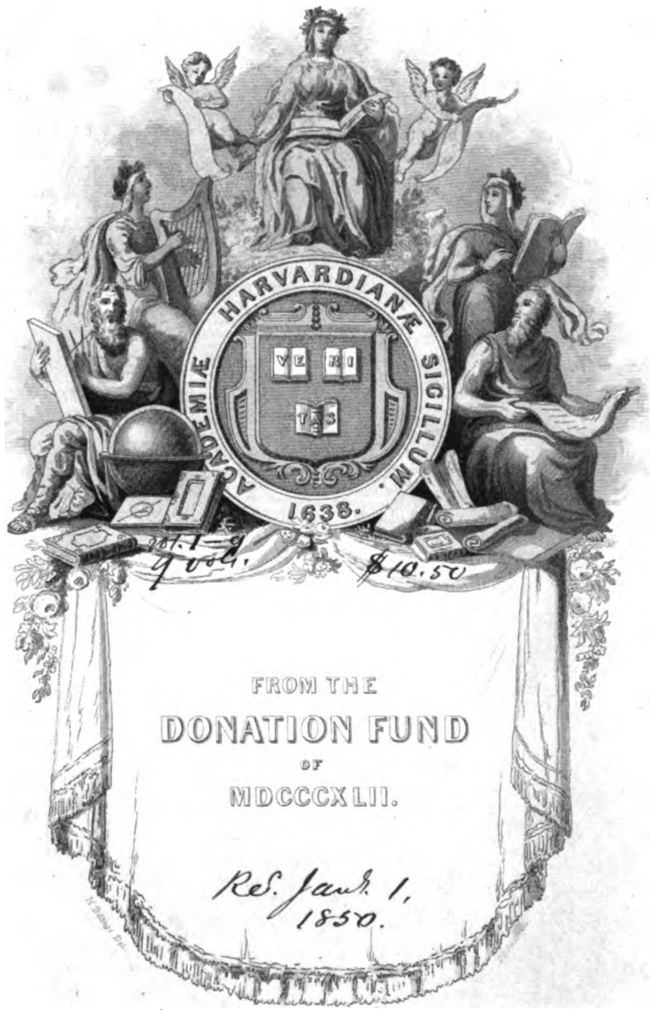


Mechanics' magazine, and journal of the Mechanics' Institute

Mechanics' Institute, New York (N.Y.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MECHANICS' MAGAZINE,

AND

REGISTER OF INVENTIONS AND IMPROVEMENTS.

JULY—DECEMBER.

VOL. VI.

NEW-YORK:
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MDCCCXXXV.

PREFACE.

It is among the wisest of human inventions to adopt certain precise landmarks, that we may not only know, as the revolving seasons carry us through the course of time, what progress we have made; but, by reviewing, at the return of each period, the improvements we have made, and comparing them with what we have formerly done, and what others have done in similar periods, we are enabled, thereby, to make a due estimate of the value of time, and the use we have made of it, and to make our calculations with better advantage for the future.

The present number completes the sixth volume of the "Mechanics' Magazine," and reminds us that three years have elapsed since we commenced it, with the most ardent desires to advance the improvement, and promote the interest, of one of the three great and important branches of society; and at the same time anticipating a fair and liberal reward for our labors. In the first point, we have spared no pains, and suffered no relaxation, in our efforts to effect the object aimed at; and we have the satisfaction, at least, to believe that we have done all that could have been expected, in increasing that stock of general knowledge so essential to the mechanical interest, and in assisting to disseminate and extend the glorious light of *Science*, by which, alone, the mechanic can work to advantage. But, in realizing the anticipated reward of our labors, though we have reason to present our most grateful acknowledgments, not only to those friends who have promptly favored us with that return which makes the heart glad, but also those who have contributed to our stock of necessary materials, yet necessity compels us to remind many others that "*the laborer is worthy of his hire.*"

There has been no other period since the commencement of time, when the human mind has exhibited so astonishing an era in the progress of improvement, as it is doing at present. All knowledge of the useful arts, until within three quarters of a century, appears to be little more than mere germs from which those arts are at present springing into luxuriant and rapid growth. Every day is producing new and important discoveries, as well as making improvement in the discoveries of former times. It is our wish and aim, therefore, while the ingenious and inventive are making those discoveries and improvements, and the persevering are putting them into successful practice, to collect the knowledge of them from every quarter, not only of our own country, but of every other, and present them to our readers, that each one may profit by the knowledge of the whole.

One of the principal causes of this amazing increase of knowledge in the useful arts, is the increase of civil liberty, and the knowledge and acknowledgment of the rights

of man; and it is our happy lot, not only to enjoy these in a greater degree than they have ever been enjoyed before by any other nation, but to live in a country where every one who is prudent and industrious may acquire competency, and even wealth; and where every one is respected according to his own intrinsic worth, and not according to a false value set, perhaps on the disgraceful deeds of his ancestors.

Should we be enabled by the continuance of these favors, both in many and valuable communications which we have hitherto received, and by timely remittances from those in arrears, and also by such contributions as we have reason to hope from the present increased means and knowledge of the mechanical world, we shall endeavor to render each succeeding volume of the "MECHANICS' MAGAZINE" more interesting than the one preceding it.

The subject of improvement in the useful arts is certainly of more vital importance to mankind than any other of an earthly nature; and we therefore confidently appeal to the enlightened public for that support without which our work cannot succeed, trusting that no want of assiduity on our part will "*disgrace their favor.*"

INDEX.

☞ It will be observed that, by an error in paging, 49 to 64 are twice numbered. Those marked * come after page 64.

By this error, the full number of pages do not appear, as there are actually 400 pages, or 16 extra, in this volume, beside the Index.

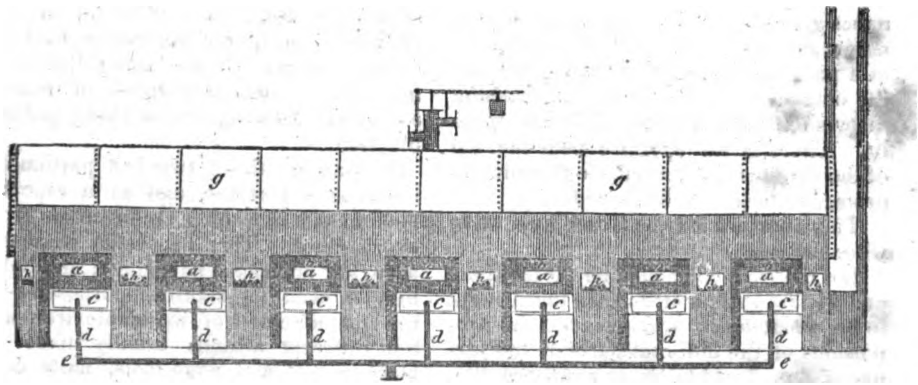
MECHANICS' MAGAZINE,

AND

REGISTER OF INVENTIONS AND IMPROVEMENTS.

[VOLUME VI] JULY, 1835. [NUMBER 1.

IMPROVED PROCESS OF GENERATING HEAT AND STEAM.



We have been favored by Mr. Clute, of Schenectady, with the annexed specification and engraving of his improved furnace.

References—*a a*, apertures for iron; *b b*, grates; *c c*, receivers; *d d*, branches of main blow-pipe; *e e*, main blow-pipe; *g g*, cylinder boiler; *h h*, apertures for coal.

Specification of a Patent granted to PETER I. CLUTE, *of Schenectady, New-York, for an Improvement in the Process of generating Heat, for forging Malleable Iron, and generating Steam to propel Machinery.*

Be it known, that I, Peter I. Clute, of the city of Schenectady, in the county of Schenectady, and state of New-York, have invented a new and useful improvement in the art or process of generating heat for forging malleable iron, and of generating steam to propel machinery for the purpose of grinding and polishing iron when manufactured, and for the other purposes for which steam power is generally employed.

The following is a description of the construction and operation of the furnaces and apparatus to be used in my invention.

Where other than a cylinder boiler, or where more than one boiler, is designed to be used, a given number of furnaces of the description hereinafter set forth, are to be erected under the same, arranged in the most convenient form, to receive as many points of the boiler or boilers, as, according to the principles hereinafter laid down, may be deemed most expedient; as, for example, in a circular form.

The *cylinder* boiler, however, I deem best adapted to the contemplated purposes of my invention.

Where the cylinder boiler is used, the number and size of the furnaces will vary according to the size of the boiler, and the quantity of steam required to be raised. The furnaces are to be built in a straight line, of uniform width and height, equidistant and continuous, the boiler to be laid horizontally or lengthways on the top of the furnaces. There is an aperture at either end of each furnace, through which the coal is shoved on the grate, and the fires fed as occasion requires. Under each grate there is a box, which I shall designate by the

name of receiver, because it receives the blasts from the blow-pipe and the ashes falling through the grate. The receiver may be taken out and cleaned when necessary. Each receiver has at one of its sides an aperture for receiving a branch of the blow-pipe. There are, of course, as many branches to the main blow-pipe as there are furnaces, and the blow-pipe is connected with the bellows, which is worked by the steam the heat of the furnaces generates. The branch blow-pipe enters the receiver about at its centre, at a point equidistant from the grate and the bottom of the receiver, thus causing the wind in the receiver to circulate equally. There is an aperture near the top of the furnace, in front, through which to protrude the iron to be heated.

This aperture may be closed by a valve when not used.

Let the cylinder boiler be 20 feet long and 2½ feet in diameter; then there ought to be about seven furnaces, and the proportions of the different parts of the furnaces, &c., ought to be, as nearly as may be, as follows: Distance between the grate and the boiler, twelve inches; length of grate, eighteen inches; width of grate, eight inches; width of the furnace to correspond with the size of the grate; the aperture at either end, to admit the coal, to be 8 inches in width, and 6 inches in height; the receiver, 8 inches in width, and 6 inches in height; aperture for receiving the blow-pipe, 1½ inch in diameter; aperture through which to heat the iron intended to be worked, 6 inches in width, and three inches in height; distance between each grate, three eighths of an inch; diameter of blow-pipe, 4 inches, and diminished to one inch and a half at the entrance into the receiver.

The strength of the blast required is equal to that of a blacksmith's fire. The degree of heat may be regulated by valves placed in the blow-pipe.

I do not claim to have discovered or invented any thing new in the construction of the furnaces *abstractly* considered, or in any of the apparatus connected with the steam engine, nor can my invention in strictness be considered as an improvement of a machine or instrument previously patented; nor can it be considered an application of an old instrument or machine to a new purpose. What I claim as *new*, and my own invention, may be reduced to the following particulars:

1st, The using a number of furnaces to raise steam; 2d, the process of heating the boiler *uniformly* at many points, thus differing from the universal practice which now obtains, of heating the boiler at one particular point; 3d, the employing the same steam raised by the furnaces in driving the bellows connected with these furnaces; 4th, the application of the blow-pipe to ignite anthracite coal for raising steam; 5th, the using the same fire for the double purpose of raising steam and heating and working malleable iron.

I consider these two last particulars the most important, and as in especial manner distinguishing my invention from every other. This apparatus possesses a highly important advantage, in that it may be used for *manifold* purposes—for the manufacture of malleable iron into the different articles usually made by blacksmiths, and edge tools, nails, &c., and the steam power may be applied to grinding and polishing the iron, when manufactured, to propelling boats, driving a trip-hammer and mills of every description, and the other purposes for which steam power is generally employed.

PETER I. CLUTE.

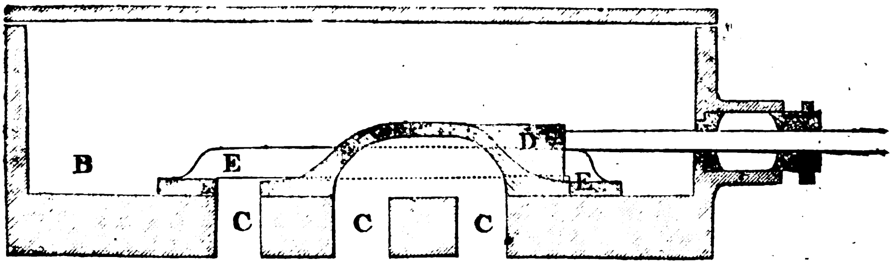
[For the Mechanics' Magazine.]

Specification of a Patent granted to THOS. B. STILLMAN,* *for an Improvement in the Valves of Steam Engines.*

To all whom it may concern—Be it known, that I, Thomas B. Stillman, of the city of New-York, in the county and state of New-York, have invented a new and useful improvement in the valves of steam engines, the object and intent of which is to combine the common slide steam valves with a cut-off valve, so that both may be operated by the same eccentric, or cam, upon the same seat, and each retain their distinctive character for the particular purposes of a steam and cut-off valve. And the method by which I obtain such object is fully set forth in the following specification, and in the drawings thereunto annexed, which make a part of said specification.

The valve which I propose to adopt, will apply, with trifling variations, to

Fig. 2.



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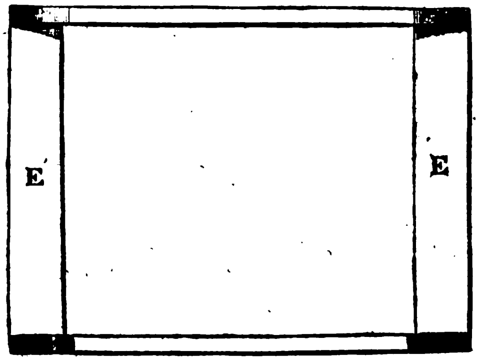


Fig. 4.

most of the different forms of sliding steam valves that are now in use. But the form to which I shall confine myself in this description is that called the single short slide valve, the adaptation of said valve to which will enable me to explain its principle in the fewest words.

Fig. 1* is a perspective of a steam chest containing the steam and cut-off valves, as hereinafter described. Fig. 2 is a longitudinal section of steam chest and valves. Fig. 3 is a plan, and fig. 4 is a side view of the cut-off valve. The letters of reference designate the similar parts in the several figures. A A is a steam chest, the lever being removed to show the valves within. B is the valve seat, which is made somewhat longer than the usual proportions, for the purpose of admitting the cut-off valve upon it, within the steam chest, and also to allow the steam valve more vibration than is commonly necessary. C C C, are the openings in the valve seat, over which the valves operate. D is the common slide valve, with the valve rod passing through the end of the steam chest. E E is the cut-off valve, which may be formed of several pieces, or cast in one piece of brass, or other metal suitable for the purpose. The two ends of this valve are faced to suit the face of the valve seat, and the inner edges are jointed to the ends of the steam valve so as to be steam tight when in contact, which will be alternately at each end of the valve when in operation. The distance between the inner edges of the ends of the cut-off valve should be equal to the length of the steam valve, and of one of the openings in the valve seat. Through the space formed by this difference of length, the steam enters the openings. But the stroke of the valve is not complete until the end of the cut-off is drawn over the opening now seen between the two valves in fi-

* Fig. 1 is omitted.

gure 1. The steam will be cut off at half stroke, if the valves are worked by an *eccentric*, but when a *cam* is used, it may be cut off at any required proportion of the stroke. When the operation of the cut-off is not required, as in starting the engine, the stroke or throw of the valve is diminished by means of a moveable arm in the rocking shaft, with an adjusting screw, or otherwise, which decreased stroke leaves the cut-off valve nearly at rest upon the valve seat, while the steam valve continues to perform its functions. It is not essential that the cut-off valve should preserve the frame form that it has in the drawings; the ends may be separate from each other, and connected to the steam valve, or a single connection over the steam valve would answer. But I prefer the present form, as it is not only better, on account of strength, but is more easily confined by the springs which I cause to bear upon each side, to prevent its sliding upon the valve seat, except as impelled by the steam valve.

What I claim as my invention and improvement in valves of steam engines, is the attaching of the frame or valve, as above described, to the common slide valves by which they are combined, so as to require but one eccentric or cam, for their proper movement and effect, both as a steam and cut-off valve, the whole being effected substantially as above described, and in any required proportion, according to the size of the engine.

In witness whereof, &c.

December 1, 1833.

The following letter from Mr. Thomas, of Keeseville, refers to a subject, which, though it has been some time before the public, appears from various causes to have received but a small portion of the attention it merits. To find the true solvent for caoutchouc, or Indian rubber, was a desideratum long sought for by ingenious and scientific men, and great anticipations of the benefits to be derived from it were indulged in, if it could be found; but great as they were, they appear to have borne scarcely the slightest proportion to what proves to be the reality, now that the solvent is found. The benefit of the discovery being secured by letters patent to the discoverer, makes it the business of him and his assigns to extend the application of it to its various uses; but so amazingly extensive is its usefulness, that years, and even ages, may pass away, before it shall be applied to all the purposes it is calculated to answer. When we see its wonderful efficiency, not only in rendering cloth impervious to air and water, but in joining the edges together without sewing—when we see not only cushions to sit on, but beds to lie on, filled with air, so that a stage passenger can sit all day upon a seat, and sleep at night upon a bed, infinitely softer than down—and deflating both in a moment, wrap them up and tuck them in a corner of his trunk or wallet—who, after seeing all this, will attempt to prescribe limits to the uses of such an invention, or who would be without a suit of clothes of it to wear in wet weather, if he could get them? I know not what calculations are made by the proprietors to extend it, but I will venture to say, when the patent expires, if not before, few sails will be seen which are not prepared with Indian rubber; and I think, also, the Mechanics' Magazine may be benefitted by the communications of Mr. Thomas. S. B.

Keeseville, Clinton co., N. Y., May 17, 1835.

S. Blydenburgh, Esq.: Sir,—In this age of "Indian rubber," will you permit me to submit to you, whether the application of that article to the sails of vessels of every description would not be highly advantageous to the interests of merchants and the government? Some of the advantages which have occurred to me as likely to be derived from its use, are the preservation of the cloth from mildew, its rendering the texture firmer, more elastic, and of course capable of enduring greater tension when in use. In wet weather the sails would be lighter, and more easily managed. I think if coal tar be the solvent used in making the varnish, the expense attending the pro-

cess of covering the cloth would not be equal to the benefits arising from its use; but in this I may be in error.

I can think of but one objection to its use: it is *possible* that spontaneous combustion might ensue when sails should be stowed away in large quantity, and in a *close*, *warm* situation.

If you think, sir, the suggestion has any value, please communicate it (if new) to your friend Mr. Minor, of the Mechanics' Magazine, and oblige, very respectfully, your obedient servant,

J. Thomas.

On the Use of Plated Glass as Sheathing for Ships' Bottoms.

To the Editor of the Mechanics' Magazine:

Sir,—Much ingenuity has been employed for a long time to invent a sheathing, or bottom, for ships, which would not be subject to corrosion by salt water, and at the same time avoid the accumulation of animalculæ and dirt attendant upon most bottoms which have heretofore been used.

I have thought that the following plan would be free from the usual difficulties, and have taken the liberty of introducing it to your notice. It is possible, however, that it may not be new, and that it may have been tested, but, as far as I have been able to learn, it has not. It consists of plates of different dimensions, size, thickness, and shapes, adapted to the size and form of the ship to be plated. They are to be made from glass, and the same earth and clay from which the wares denominated stone, earthen, and crockery wares, are made, (or from any others capable of being applied to such purposes,) and are to be polished in the same manner, or in any other way, on that surface intended to be exposed to the water. They are to be made with holes of sufficient size to admit screws or nails to pass through them for fastening. These holes are to be so formed, that the nails or screws shall catch and hold the plates below their outer surface. The cavities between the heads of the screws or nails, and the outer surface of the plates, and the crevices, or space between the plates, are to be filled with water lime, or any other matter, or composition of matter, which will protect the heads of the screws or nails from corrosion, and the bottom of the ship from the water, and give the plating a smooth and even surface.

If I am acquainted with the nature of the articles from which the above plates are proposed to be made, they will not be subject to corrosion, will resist all attacks by animalculæ, keep clean and smooth, and will not be worn by the friction of water. By their being made about one inch, or an inch and a half in thickness, and about a foot square, they will possess much strength. There is an objection which may be insuperable: that is, their danger of being broken by anchor cables. If that be an objection, perhaps it might be obviated by using copper, or some plan might be invented to prevent the cables from coming in contact with the bottom.

I presume that others may have thought of using glass for ships' bottoms, and I have heard it suggested that glass would do away all difficulties; but the suggesters have been at a loss to know how it should be put on to bottoms. If the putting of it on is all the difficulty, it is obviated by making it into such plates as I have described, and I am not aware that this plan has ever been proposed or tried by any person.

Many would look upon a plan for glass or stone ship bottoms as ridiculous; but when they come to consider, that these bottoms are composed of plates of a small size, and of considerable thickness, which renders them much stronger than a whole bottom of glass or stone, and far less liable to be broken, and if broken easily repaired, they might be inclined to regard it more favorably. The expense for plating a ship with these could not vary much from the present expense of coppering; but when a ship is once plated with glass, it is, as it were, plated forever, unless by some sudden blow upon the bottom it might be broken. We do not, however, expect a ship to strike the ground, or a rock, without doing great damage, whatever may be her bottom.

I have thus troubled you with an imperfect and disconnected statement of what I conceived might be an improvement in ship's bottoms; and I have endeavored to give you a few of my ideas in relation to it. They may be correct, and they may be grossly incorrect. If it should be deserving of any notice by one so capable as yourself to judge of its merit or demerit, I shall be much gratified and honored; if it is not, I shall not be disappointed. If my plan, or any part of it, shall be worthy of notice, I no doubt shall find that notice in your valuable Magazine; if it is not, I shall expect it to be treated accordingly.

I shall, in any event, have the consciousness of having made an endeavor to benefit mankind.

Yours, very respectfully,

Roskim.

Utica, March 31, 1835.

Aerial Steam Boats.—Some sixteen or eighteen years since, I passed a day at a tavern in Hanover, N. H. with Mr. Maury,

the inventor of the rotary steam engine, used in the glass-house at Leehmere Point, and who has made numerous experiments on light, heat and combustion, and in various branches of mechanics. He stated that he should live to see the mail transported by carriages, propelled by steam, between our largest cities, and that I should live to see it carried in steamboats through the air. On expressing doubts of the practicability of the latter improvement, in the mode of transmitting intelligence, he went into a long argument to prove, that it was not only possible, but absolutely easy of accomplishment. It has been ascertained, he observed, that large weights can be elevated high above the earth, by balloons filled with air, lighter than that of the atmosphere. The first grand step, then has been securely taken, and it is only necessary to apply a power which shall give the balloon a horizontal motion, when a rudder can be applied to guide it, and this can be done by a steam engine, working paddle-wheels as in a steamboat on our waters, but each of the paddles to move on an axis so as to offer no resistance, after having struck the air in one direction. The balloon must be constructed in the form of a fish, or in other words, have length, and such a structure as will be most easily propelled and guided, while space is afforded for the machinery and passengers. He had estimated the requisite size of a steam aerial boat to sustain an engine capable of propelling it sixty miles an hour. After many details, this intelligent, ingenious, and sanguine gentleman, closed his remarks with this bold and prophetic declaration, "You, sir, if you live to the common age of man, will see aerial steamboats rise up out of our large cities every morning, like a flock of wild geese, and take their several directions to the various parts of the Union, laden with the mails and passengers."

Notwithstanding the doubts which are generally entertained of the ultimate benefit to be derived from balloon experiments, a very scientific man, many years since, did foretell the establishment of railroads, and may not be mistaken as to the aerial ocean being successfully navigated. It would not be more wonderful than was the first steamboat which the illustrious Fulton launched upon the Hudson, or the sight of the first locomotive, which sped like the wind from Liverpool to Manchester.—[Boston Atlas.]

A Railroad from Athens to the Piræus is stated by the Munich Journal to have been contracted for by the Greek Government, with the banker Fereldi.—[Lond. Mech. Mag.]

[For the Mechanics' Magazine.]

LOCOMOTIVE STEAM ENGINES.

The friends of the resolution for taking off the duties from locomotive steam engines, which was brought forward during the last session of Congress, urged in support of that measure the incompetency of the workshops of this country to supply the demand, and the inferiority of American locomotive engines.

It may be interesting to some of your readers to learn how little this argument is supported by the facts of the case. In a visit to the workshop of Mr. M. W. Baldwin, of Philadelphia, from which I have just returned, I collected the following information: Mr. B. has delivered from his workshop, within the last twelve months, ten locomotive steam engines, has six now in his shop in a state of great forwardness, some of which are nearly completed, and has contracts on hand for about twenty engines, for the following roads, viz.: the Columbia, Pa., State Road; the Trenton, the Newark, the Jamaica, the Troy and Saratoga, and the Utica and Schenectady roads. Under his present arrangements, he informed me that he gives employment to about 150 persons, and is able to complete an engine about every three weeks; and, to meet the increasing demand, is erecting workshops which will accommodate 300 hands.

As regards the character of these engines, there are seven of them at work on the Pennsylvania State road, upon which they have also two English engines, from the workshop of their most celebrated maker, R. Stephenson.

The engineer who has charge of the locomotive department on this road, informed me that the power of the American engines is about 35 per cent. greater than that of the English, and that the loss of time, and cost for repairs, is *altogether in favor of the American engines:* five hands, as he stated, having been sufficient to keep all the seven in order.

For the gratification of such of your readers as are interested in railroads, I will refer to the principal points of difference between the English and American engine, and what I conceive to be the peculiar advantages of the American engine.

It is well known, that the crank-shaft, and the wheels, of the locomotive engine, have been by far the most troublesome and expensive part of the machine to be kept in repair. By the improvements in Mr. B.'s engine, these difficulties have been obviated, as has been proved by experiment. Of the 7 engines on the state road, and 2 on the Trenton road, some have been at work since the 1st of July last, and in no instance has a

crank broken, or worked loose, or any of his improved wheels failed, or given trouble.

It is here proper to observe, that the Pennsylvania road is almost a continued series of curves, ranging from 500 to 700 feet radius, and so severe is it upon the wheels of an engine, that one of the English engines, (the other having been out of repair most of the time,) has within 2 months used up or destroyed a part of the wheels of both engines, and is now using a set of Mr. Baldwin's wheels.

The other improvements affect the force-pump, eccentrics, and reverse gear, all of which are so much simplified that the joints and working parts are not more than half as numerous as in the common English engine. The steam pipes have all ground metallic joints, and no cement or soft solder is used in any of the joints of the engine.

Another very important improvement has been added, by which the adhesion of the driving wheels may be increased at will, from 35 to 50 per cent. By this means, one of these engines, with only 6487 lbs. on her driving wheels, as a fixed weight, has carried a gross weight of 80 tons up an inclination nearly two miles in length, of 35 feet per mile ascent, without any perceptible slipping of the wheels.

The great object of the whole of these improvements has been to strengthen the weak points in the machine, and to simplify and reduce the number of its parts; and so fully has this object been accomplished, that this engine may justly be considered the most perfect of its kind now in use.

A Friend to American Manufactures.
New-York, June 16, 1835.

[From the American Railroad Journal.]

We have been again favored by Mr. G. Ralston, of Philadelphia, now in London, with an interesting letter, from which we make the following extract; and we take this method of returning our thanks for the numerous favors conferred upon us and our readers, by Mr. Ralston, in forwarding early accounts of improvements in the construction of railroads and railroad machinery. He will please to accept our especial thanks for the Report of Dr. Barlow, "on the transverse strength and other properties of malleable iron," of which we shall endeavor to give a full account in our next number; and also for the papers on "Pneumatic Railways," one of which, containing the opinions of Professor Faraday and Dr. Lardner, will be found in this number.

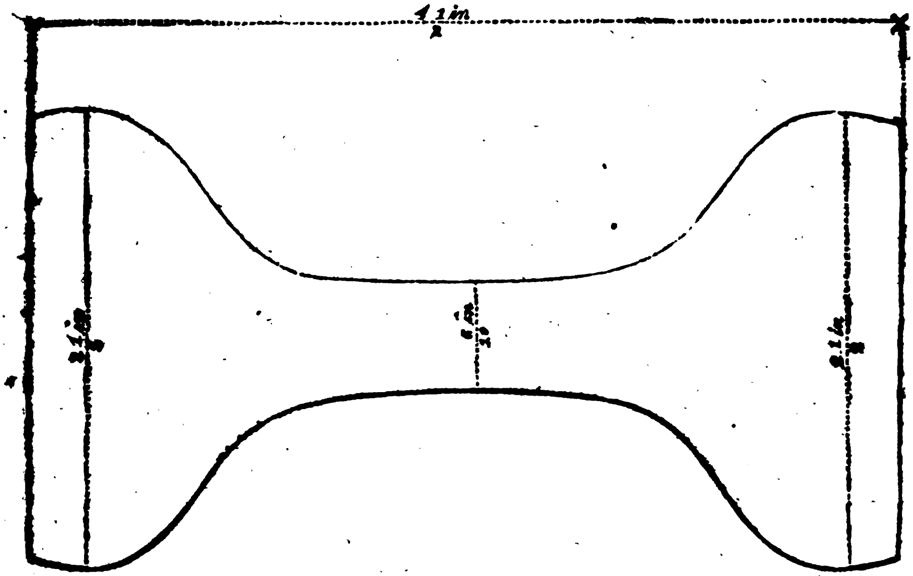
Of this "new plan" we confess that we are not able to form an opinion, as we have time only to *print*, not to read it. We shall take time to read the other before it is published, and hope then to be able to give a more correct idea of the project than we now possess.

London, May 12, 1835.

Dear Sir,—I observe by the "American Railroad Journal," which I received from New-York yesterday, that you have published two papers* which Mr. Robert Stephenson kindly allowed me to copy from his original MS., and which I sent to the "Journal of the Franklin Institute" in Philadelphia. These articles are, 1st, Mr. S.'s Report on the "Undulating Railway System," and 2d, his "Remarks on the best form for Railway Bars."

I am very much pleased that you insert matter of such excellent quality in your useful Journal, and to enable you to continue the subject "of the best form of rail," I beg you will accept a book I send herewith, being a Report and Appendix made by Professor Barlow to the London and Birmingham Railway Company on this subject. You will observe that he controverts Mr. Stephenson's arguments in favor of "fish-bellies," and gives a decided preference to parallel rails. I think this report will please your numerous readers. I must call your attention to the circumstance that, on the Liverpool and Manchester Railway, they are now taking up (as rapidly as is convenient) the fishbellies of 35 lbs. per yard, and laying down in their place parallels of 60 lbs. per yard. You know the increase of weight of locomotives on this road is very considerable; they formerly weighed 4 or 5 tons—they now weigh 10, 11, and 12 tons. So also on the Stockton and Darlington Railway, the rails originally weighed 28 lbs. per yard; they have removed them, and substituted rails of 45 lbs. per yard. On all the railways in use, or being constructed in this country, they consider heavier locomotives, and of course stronger rails, as most expedient and economical. Enclosed I send you a tracing of the new rail for the "Grand Junction Railway," (from Birmingham to Warrington, to make the connexion, by railway, from London to Liverpool.) [See accompanying figure.] You will observe that it is a parallel rail, of 60 lbs. per yard, and that it is somewhat in form of Mr. Robert Stevens's (our distinguished countryman) T rail—having as much base, which rests upon the ground, as surface for the wheel to run upon. The Engineer of this railway is Sir George Stephenson, (lately knighted by the King of the Belgians,)

* See Mechanics' Magazine, vol. v., pp. 169, 269.



the father of Mr. Robert Stephenson, who is the Engineer of the Birmingham and London Railway. These two eminent men being in habits of constant intercourse, I think it highly probable that this form of rail has been adopted with the sanction of both of them; and if it be so, the fishbellies will never come into favor again.

I also send you two papers on the "Pneumatic Railway System," contrived and patented by our countryman, Mr. Pinkus, of Philadelphia. The shares for the Company have all been taken with great eagerness, and a line of a few miles in length is to be immediately laid down near London, for the purpose of testing its practicability and utility. The members of the association, as well as many others, are very confident of success; but we shall soon see whether it will answer as well in practice as it promises in the working model.

I am very much pleased that you advocate with so much ability and zeal that magnificent project, a railway from the Hudson to Lake Erie. I read your articles with deep interest, and hope your judicious exertions will be crowned with success. As I am in the midst of railway iron, locomotives, and persons connected with all projects of internal improvements, I will be happy to serve you, or the readers of your excellent Journal, by procuring information, or in any other way that may be pointed out to me as acceptable.

I am, very respectfully,
Your most ob't serv't,
GERARD RALSTON.

Opinions of Prof. Faraday and Dr. Lardner upon the Pneumatic System of Railway.

Royal Institution, 3d Feb., 1835.

My dear Sir,—The points in your letter of the 26th of last month, which you put to me for an opinion, are such that I have no hesitation in agreeing with you upon them. To enumerate briefly these points:—the *principle* of communication of power is correct; the use of local steam engines is highly advantageous, both for cheapness of force and capability of varying it when required; the necessity for levels will, I presume, therefore be greatly obviated; the association of cylinder and rails is such, that the whole road must (with sufficient thickness in the cylinder) have great strength and firmness; the absence of locomotive engines removes much of the cause of derangement which the road would have to sustain; and I do not see how the governor and carriages can leave the railway.

You know my objection to giving a general opinion in reference to the profitable application of the plan in question; but I may here add, that the reserve I feel originates simply in my possessing no practical knowledge of the construction, expense, and profit, of ordinary railroads.

I am, my dear Sir, very truly yours,
M. FARADAY.

Wm. Hosking, Esq., F. S. A., &c.

—

I have read the specification of the patent for the pneumatic railway and the accompanying papers, and have also examined

the drawings and models which have been submitted to me by Mr. Hosking.

Two methods have been heretofore employed for rendering steam power available in transport upon railways; one by causing a travelling or locomotive engine to move with the load which it draws, the other by constructing, at intervals of about a mile and a half, stationary steam engines, the power of which is transmitted to the load by a rope carried along the road upon rollers or sheaves placed between the rails. The train being attached to this rope, is drawn by the power of the engines from station to station. The object of the pneumatic railway is to substitute for the rope a partially-exhausted tunnel; to employ the fixed steam-engines to work air-pumps, by which a rarefaction of the tunnel shall be maintained; and to cause the trains to be tracked upon the railway by connecting them with a diaphragm or piston placed in the interior of the tunnel, so as to have that part of the tunnel in advance of the piston rarefied by the engines, while that part behind the piston is open to the atmosphere. An effective impelling power is thus obtained equivalent to the difference between the pressure of the atmosphere on one side of the diaphragm and of the rarefied air on the other.

Of the practicability of this project I think there can be no doubt. The working of large air-pumps by an adequate moving power, and the rarefaction of air in tubes or tunnels by such means, is not a new idea. It was suggested by Papin, in the latter end of the seventeenth century, and was even pointed out by him as a means of transferring power to a distance, without the loss by friction and other causes consequent upon the use of ropes or other ordinary means of transmitting force.* It is, in fact, a well understood principle in physics, that whatever moving force be expended in producing the rarefaction of air in a cylinder or tunnel, must necessarily be followed by a corresponding force on the other side of a diaphragm moving air-tight in that tunnel, and exposed to the free action of the atmospheric pressure. In the present case, supposing the structure of the valvular cord and the pneumatic piston to be perfect, the opposite side of the diaphragm will always be pressed by an effective impelling force, the amount of which may be calculated upon these principles. It will of course be perceived that no original moving power is obtained from the tunnel, or from the rarefied air; the rarefaction gives back the power expended by the stationary engines and nothing more; and the tunnel must therefore be regarded merely as a substitute for the ropes in the common method of working railways by stationary engines. But it is evidently attended with several advantages in comparison with the latter. A very large proportion of the moving power of stationary engines worked by ropes is intercepted by the resistance from the weight and friction of the ropes, sheaves, barrels, drums, &c. All such waste of power is removed by the pneumatic tunnel.

The original expense of ropes and their wear and tear would be likewise saved. Some notion of the extent of this saving may be collected from the following facts: when the Liverpool and Manchester railway was about to be brought into operation, a question arose as to the expediency of working it by stationary engines, and estimates of the expense were made by competent engineers. The total amount of capital to be invested in moving power was estimated at about £120,000; of this above £25,000 was devoted to ropes, sheaves, drums, and other necessary accompaniments. The total annual expense of maintaining the moving power was estimated at £42,000, and of this about £18,000 was appropriated to the wear and tear of ropes, sheaves, &c. Thus it appears that the method of transmitting the power of the stationary engines to the trains by ropes would absorb about 20 per cent. of the invested capital, and their maintenance would consume about 43 per cent. of the annual expenditure.

Another source of comparative economy would obviously be the diminished number of stationary engines. In the estimate already referred to, it was calculated that the distance of 30 miles should be divided into 17 stations, with two 40 horse engines at each station; besides these there would have been two engines at the bottom of each inclined plane, one at the tunnel, two at the top of the planes, and one at the Manchester end, making in all 42 stationary engines to work a line of 30 miles. Now, according to the estimate of the patentee of the pneumatic railway, from three to six stations would be sufficient between Manchester and Liverpool, and the whole line would be worked by from six to twelve steam engines. Putting aside therefore the saving of power which would arise from the substitution of suction in the tunnel for ropes, and supposing the amount of stationary power in both cases to be the same, it will be evident that a material saving would arise from the circumstance of that amount of power being derived from so much less a number of engines,—the number of engine-

* Papin proposed to obtain an active force at one end of an extended tube by the application of water power at the other.—W. H.

men, assistants, &c., besides the interest on capital, being considerably less.

Some notion of the economy of power likely to arise from superseding the use of ropes may be collected from the result of experiments made by Messrs. Stephenson and Locke on the resistance arising from the friction of ropes. They found that a load of 52 tons drawn by stationary engines worked by ropes through mile and half stages, offered a total resistance amounting to 1156 lbs.; of this 582 lbs. arose from the friction of the load, and 574 lbs. from the friction of the ropes. In the case of the pneumatic railway, the friction of the rope is replaced by the friction of the air-pumps and of the impelling apparatus, and it will be evident that the latter, compared with the former, must be almost insignificant. Hence the power wasted in its transmission from the stationary engines to the load, which in one case amounts to 50 per cent. of the whole moving power of the engine, in the other is of comparatively trifling amount.

Slopes on railways will always be objectionable whatever power be used; for even the most gentle ascent will increase the resistance of the load in an enormous proportion. The difficulties, however, which they present are materially less when the line is worked by stationary than by locomotive engines, and would be still further diminished by superseding the rope; the resistance arising from the rope being always greater on inclined planes than on the level, owing to its increased thickness and consequent weight. A load which requires a 4½ inch rope for the level requires a 5½ inch rope upon a slope of 1 in 100. The weights of equal lengths of these ropes would be in the proportion of about 2 to 3, the slope requiring one-half more weight of rope than the level. Besides this, the moving power on a slope, in addition to the ordinary friction which it has to overcome on the level, has likewise to draw up the weight of the rope, —a resistance which will be increased in proportion to the acclivity of the slope.

The disadvantages produced by slopes when locomotive engines are used are still more formidable. The same engine which is fitted to work upon the level is altogether inadequate for the slopes, the consequence of which is, either that the locomotive is strained beyond its power by working up the slopes, and rapidly destroyed, or that the engines must be more powerful than is requisite for the common level of the road, and thus power and expense wasted; or finally, that an auxiliary engine must be kept constantly ready at the foot of each slope, with its fire lighted and its steam up, ready to help up the trains as they arrive. Unless the trains be almost incessant (which, even on the most frequented railroad, they never can be,) this last expedient, which is the one adopted on the Manchester line, is attended with great waste of power and expense. Stationary engines worked on the pneumatic principle would effectually remove all these difficulties and objections.

The weight of the trains which could be drawn upon the pneumatic railway, and the speed of the motion imparted to them, would entirely depend upon the power of the stationary engines. As the friction or other resistance does not increase with the velocity, the same absolute expenditure of power would draw the same load at whatever speed. The high speed attained by locomotive engines has been attended with great expense, but this has not arisen from the increased expenditure of power. It has been caused by the wear of the egines themselves, consequent on their rapid motion on the road, and by the necessity of sustaining a fierce temperature in the fire-place, in order to be able within the small compass of these engines to generate steam with sufficient rapidity to attain the necessary rate of motion. As the magnitude of the stationary engines would not be limited, and as they would not be subject to the injurious effects of motion on the road, steam could be produced in sufficient quantity for the attainment of any required speed, without increasing its cost, or in any way impairing the machinery.

One of the obstacles to the attainment of great speed by stationary engines worked by ropes, is the delay produced in transferring the trains from engine to engine, and from station to station. The momentum imparted to them is lost at each change, and these changes occur every mile and a half, so that the train has scarcely attained its requisite speed, when its motion must again be checked in order to hand it over to another engine. This difficulty is removed by the pneumatic system: there being no rope to be detached and attached, the engine passes on by its momentum from station to station, and a contrivance is provided by means of a valve at the stations, by which it is brought under the operation of the next engine without stopping its motion.

Although the danger of accidents to passengers on the present railways worked by locomotive engines is considerably less than that of travelling by horse coaches on turnpike roads, yet serious accidents have occasionally occurred. These have generally arisen either from the locomotive engine running off the rails, from one train running against another, from the locomotive engine breaking, or, finally, from persons standing

upon the rails being run down. In the pneumatic system there is almost a perfect security from these causes of danger. From the engines being stationary, and the tunnel rising between the wheels of the trains, it is evidently impossible for the carriages to run off the road; and from the manner in which the system is worked, it is impossible that one train can run against another. It happens also that the nature of the rails themselves, forming, as they do, merely ledges upon the sides of the tunnel, prevent the possibility of persons standing between or upon them.

In railways worked by stationary engines, serious accidents have occasionally occurred by the ropes breaking, while the train has been ascending a slope. In such cases the train has run down by its weight with a frightful rapidity, producing the destruction of the carriages and the loss of life. It is evident that this source of danger is removed by the pneumatic system.

An advantage possessed by this system above the edge railroad, deserves to be particularly noticed. In the edge railroad, the engines and carriages are kept upon the road by flanges, or ledges, raised upon the tires of the wheels, which press on the interior of the rails. Every thing which causes the carriages to press on the one side or the other, causes these flanges to rub against the rails. When a curve or bend happens in the road, the carriages are guided by the pressure of one or the other flange on the side of the rail, which of course is accompanied by considerable friction. In the pneumatic railway there are no flanges, either on the wheels or rails; the carriages are guided by wheels, or rollers, placed in a horizontal position, and acting upon the external sides of the channel which receives the valvular cord. By this means all resistance which arises from what is called rubbing friction, is removed, and every surface which moves upon another, moves upon it with a rolling motion.

It is well known, that notwithstanding the prosperous condition of the Manchester Railroad Company, yet their expenditure in locomotive power has been so enormous as to cause considerable anxiety on the part of the managers, and some of them have even inclined to the opinion, that the question of stationary power deserves to be reconsidered. This opinion would probably be confirmed and strengthened, if the practicability of the pneumatic system were satisfactorily demonstrated by experiment upon a sufficiently large scale.

On the whole, it appears to me that if the mechanical difficulties of maintaining the pneumatic tunnel sufficiently air tight be overcome, the system presents a fair prospect of being practically successful. These difficulties are not so great as they may at first appear. It should be recollected, that nothing approaching to the *exhaustion* of the tunnel can be necessary; nor even any considerable degree of rarefaction. Supposing the tunnel to have an internal diameter of 40 inches, the impelling diaphragm would have a surface of about 9 square feet. If in such a tunnel a degree of rarefaction were produced, sufficient to cause a barometric gauge to fall two inches, (which would be an extremely slight degree of rarefaction indeed,) an impelling force would be obtained amounting to one pound on every square inch of the surface of the diagram, which would give an impelling force of more than half a ton. It is calculated, that on the common railways the amount of load is above 200 times the force of traction, and it would therefore follow, that this force would be sufficient to draw a load of 100 tons. If an additional inch of mercury be made to fall in the barometric gauge, to balance friction, &c. still the rarefaction would be extremely inconsiderable, and the contrivances to prevent leakage would appear to be attended with no great mechanical difficulty.

From the various reasons which I have above stated, I am of opinion that the present project would, if carried into execution, be likely to be attended with greater economy and safety than any other method of working railways now practised; and I see no reason against the attainment of as much speed as is obtained by the locomotive engines. At all events, having explained the reasons on which I have grounded this opinion, every one can judge to what weight it may be entitled. The project would appear to be well deserving of trial on some railroad of limited length, such as that between London bridge and Greenwich, where it would be sufficient to have stationary engines at the extremities. In such a case, I see scarcely any limit to the speed which might be attained with safety; and the economy, as compared with locomotive engines, would probably be very great. DION. LARDNER.

London, Feb. 19, 1835.

EXPERIMENTS TO PRODUCE LIGHT IN WATER.—An experiment, to ascertain at what depth a white object might be visible in the sea, has just been made by a gentleman who has devoted much time and attention to extend the bounds of science. Having let down a metal plate, painted with white lead, he was able to distinguish it by moonlight at the depth of forty feet; while, by that of the sun, he lost sight of it at about eighty feet. The difference must

seem surprising when we compare the intensity of the two lights—that of the sun being, according to Bougner, *three hundred thousand times* stronger than that of the moon; but the dazzling which affects the eyes by the corruscation of the solar rays, does not allow us to be sensible to feeble impressions on the visual organs. Any instrument, therefore, which should enable us to see at great depth under water would be exceedingly useful, either in recovering any object that might be lost, or in constructing submarine works in sea-ports. A method used by fishermen to obtain this advantage consists in pouring oil upon the water, to make it more transparent. In the bay of Naples it is constantly practised by the fishermen at night. Their boats are provided with a composition which gives an intensely vivid flame, and is placed out at the stern. Attracted by the light, the fish follow it from every direction, keeping near the surface, and hovering around it like moths. They are then easily captured, after being struck or harpooned by four-pronged spears. Those who search for shell-fish (frutti di mare) in the day-time, near the shore, employ the same method, throwing little pebbles steeped in oil before them. The gentleman, who was acquainted with this simple contrivance, wishing to ascertain its efficacy, poured a small quantity of oil on the sea, and was thereby enabled to distinguish shells and other objects which had not been visible to him before. When oil is thrown on the surface of water which is not confined by banks, the coast extends itself to a great distance, becoming thinner and thinner, until it can no longer be distinguished separate from the water. The effect of the oil is, apparently, to draw off, as it spreads, those little objects which prevent the transparency of the water by floating on its surface. All the experiments hitherto made, tend to corroborate this assertion; one of them in particular is very conclusive. Half a spoonful of olive oil having been poured near the edge of a large oval sheet of water, on which the wind had blown a quantity of acacia flowers, it was observed, that, in a few seconds afterwards, one half of the surface was completely swept of these floating flowers, and that they were all collected on the opposite part. Similar experiments are still in progress.—[Literary Gazette.]

The Menai Bridge.—A friend of ours, who lately crossed this bridge, was informed by a gentleman who resided close to it, and has erected standards by which to mark the degree of vibration to which it is subject, that during the late violent gales it was on several occasions so much agitated as to oscillate to the extent of eight feet six inches—that is, four feet three inches both ways, out of the straight line. We believe, however, that even a much greater rate of oscillation than this was allowed for in the calculations on which it was constructed.

[From the London Mechanics' Magazine.]

DESCRIPTION OF THE FREYBURG SUSPENSION BRIDGE.

Translated from the German, by J. E. Terry, C. E.

The city of Freyburg, in Switzerland, is well known to most travellers for its remarkable locality, being seated partly in a deep and winding valley, watered by the river Saone, and partly on the adjacent high and overhanging cliffs. To arrive at the centre of the town, by the road from Berne, carriages were formerly obliged to descend the steep declivity of the Staalberg. On arriving at Bernegate, it seemed to travellers as if they had already got to the end of their journey, but great was their astonishment to be informed that they had yet to travel for half an hour before they could reach the city—to follow the several large windings of the river, cross it three times, then to ascend the long, difficult, and steep ascent called *Alt Brunnen Strasse* (Old Well-street), which was at all times enough of itself to dismay a traveller, and has proved the death of many a horse. The bad state of the roads, and defective plan of the streets leading to the centre of the city, increased the difficulty of approaching it. Industry, commerce, social life, all felt alike the influence of this almost isolated position of the place. But what could be done? The obstacles seemed insurmountable; the almost perpendicular cliffs on which the chief part of the town stands, seemed to mock the idea of forming a street through them of any tolerable degree of ascent; and had even this been possible, it would only have tended to increase the length of the windings. On the other hand, the idea of erecting a bridge, either of wood or stone, of a sufficient height to overcome the difficulty of the rugged ascents and descents, seemed too daring for contemplation, the height being upwards of 150 feet, and the length much greater. The expense, too, espe-

cially if stone had been employed, would have been out of all proportion to the means of the citizens; for the city is not rich, being but little frequented, and thinly populated, containing, exclusive of the suburbs, no more than 9,000 inhabitants.

Some of the more public spirited and zealous citizens, who had heard of the iron suspension bridges erected in other countries, at length proposed to raise, by subscription, the pecuniary means necessary for ascertaining the applicability of such a structure to the natural circumstances of Freyburg, and, if practicable, of actually constructing it.

As soon as the subscription reached a suitable amount, several eminent engineers were consulted, and after examination of the plans of different competitors, M. Chaley, the famous French engineer, who erected the wire bridges at Beaucaire, Chasey, and several other places in the south of France, obtained the preference. The contract agreed on with him on the 10th February, 1830, was to this effect: that he was to have, at different instalments, 200,000 (Swiss) francs, for the completion of an iron wire bridge; that the expense of the approaches on both sides, and the compensation to individuals for loss sustained in their property, should be defrayed partly by the subscribers and partly by the government; and that the contractor, M. Chaley, subject to certain conditions, should have the enjoyment of the produce from the tolls for 80 years. Some time afterwards, these conditions were considerably modified; it being agreed that M. Chaley's right to the tolls should be limited to 40 years, at the end of which time, the profits are to revert to the subscribers during 59 years, after which the toll is to cease, and the bridge to become the property of the canton, or common property.

The first general meeting of the subscribers took place on the 19th of March, 1830, when they appointed a committee of 10 members (afterwards increased to 20) to superintend the erection of the bridge.

Immediately after these arrangements, the necessary preliminary preparations were entered upon; but the political disturbances which broke out, in 1830–1, in France, and afterwards in Switzerland, but particularly in the canton of Freyburg, had a most injurious influence on the undertaking—added to which, differences arose between the contractor and the committee, which tended greatly to retard the project. The general good will of the citizens, however, and the indefatigable zeal and activity of some of the leading members of the committee, re-called ere long the dormant project into life and activity. In March, 1832, the works were entered upon with great zeal, and the first stone of one of the porticos was laid, under the superintendence of the architects Kraser and Brugger. From that time the works were continued in every department without interruption; and, to facilitate their progress, a temporary bridge was thrown over the river Saone, it being for the ease and advantage of the workmen to get from one side to the other without loss of time.

The finances of the company were all expended, however, long before the bridge approached to its completion. But though the funds were exhausted, the ardor and generous feeling of the subscribers and donors were not. Government, which, from the beginning, had given its particular sanction and protection to the measure, came once more to its assistance, by granting leave for the opening of a lottery, which produced to the company the sum of 80,000 francs.

The work was now once more renewed with vigor, and on the 9th of June, 1834, the subscribers had the gratification of seeing extended across the valley, the first of the numerous wires which form the two main ropes or supports of the bridge. Next followed the fixing of the subordinate suspension wires, and the laying down of the beams to form the foundation or flooring of the bridge. The latter mentioned operation took place, it might be said, in a magical manner. The inhabitants were not a little surprised to find at their gates an unlooked-for, and, for foot passengers, a sufficiently solid bridge, where, ten days before, they had seen only two immense wire-ropes. After this, the other various inferior works soon followed, as the completion of the footway, the erection of the balustrade, &c. At length, on the 8th October, a carriage was driven over the bridge at full gallop, which was followed, on the same day, by the stage, or post coach, from Berne to

Freyburg, enthusiastically greeted by a vast number of astonished spectators.

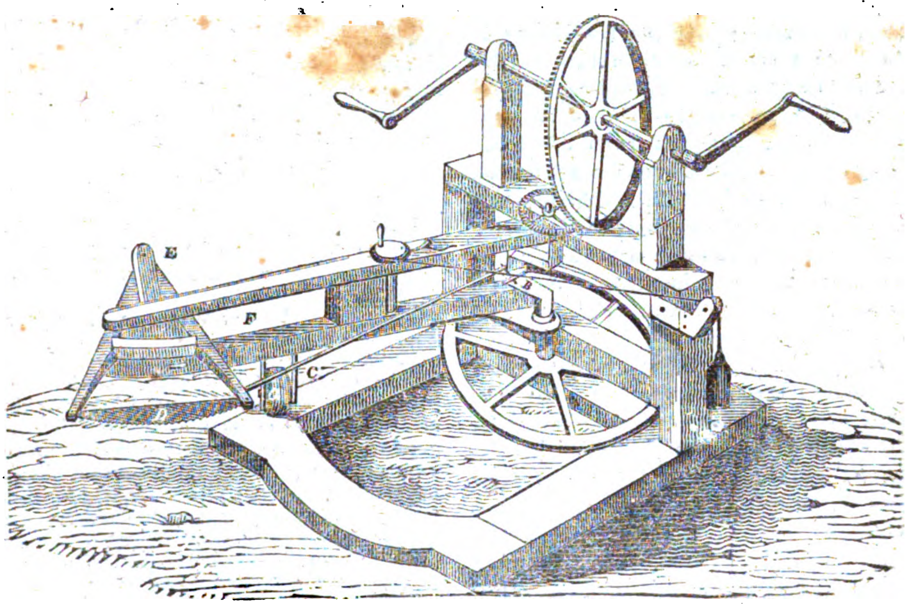
The balustrades, though simply modelled, present, nevertheless, a very handsome appearance. Any vehicle, be it ever so heavily laden, may safely venture over; and although the ear is at first rather startled at the noise of the trampling of horses, yet the most clear-sighted person cannot discover the slightest motion communicated either to the wire ropes or to any other part of the bridge. The traveller passing over does not feel the least vibration, and his astonishment finds no bounds, to think that he has arrived so soon, and in safety, across the deep gulf below.

As has been before observed, the whole structure is suspended by two large ropes of wire, firmly secured at each end, by being let into shafts made for that purpose. At each end the porticos, over which the ropes pass, serve for antagonist supporters, or counterforts. They are built partly of limestone, brought from Neuenberg and Neuenstadt, and partly of sandstone, which is got in the stone quarries in the neighborhood of Freyburg: all the blocks are, by way of greater security, connected with each other by means of iron cramps. The quantity of iron used for this purpose was 570 cwt. The height of the porticos is 65 Berne feet. The opening for the gateway is 45 feet high, 20 feet wide, and 19 feet in depth; the width of each pillar is 14 feet. About 160 feet from the porticos the shafts are situated; their depths are each 58 feet, and their diameters 32 feet. These shafts are hewn out of the rock on both sides, and comprise each three chambers, situated at a certain distance from each other, each containing three immense unwrought blocks of Neuenberg stone, to which the main wire ropes are fastened. The connecting wires or chains, 16 in number, are drawn through these vaults; they rest at the same time on 12 cast iron cylinders, and are held fast by 128 anchors or grapples, of a total weight of 1,024 lbs. These connecting ropes or ties serve the great main wire ropes as auxiliary supports, which bear up, on both sides the great beams of the bridge flooring, by means of suspension wires or ties. The length of the main wire ropes is 1,280 feet each. They consist each of 2,000 separate wire threads, which united make a mass of 4,000 threads, or little chains, of a total weight of 960 cwt. Dependent from each of the two main connecting wire ropes, or inverted arch, hang 164 smaller suspension wire ropes, at about 5 feet asunder: these are made fast above through iron loops, and below are connected with hoops of iron, into which the beam ends which support the footway are firmly fastened. The longest of the smaller dependent ropes of wire is 60 feet, and the shortest half a foot; each is composed of 25 single wires, so that the roadway of the bridge is held up by more than 8,000 single wires. The number of beams which form the foundation or platform of the bridge, amounts to 166, held together by 328 hoops of wrought iron. Four lines of beams run longitudinally throughout the whole length of the bridge, upon which rest the two footways. On both sides, to separate the carriage-way from the foot-paths, are strong oaken balustrades, made in the form of St. Andrew's cross, the height of which is 4 feet. The carriage-way is 16 feet, and each footway 3 feet, wide: so that the total width of the bridge is 22 feet. Its total length, including the two counterforts, over which the main wire ropes are passed, is 941 feet; exclusive of the counterforts, its length is 903 feet; the carriage-way alone is 864 feet. Its height above the river, when measured 30th Oct. 1834, was 163 feet.

The quantity of iron used in this work was not less than 80 tons, and of wood 135 tons.

The weight sustained by the two main wire stays is 120 tons; and it is calculated to sustain the amazing and enormous weight of 2,400 tons. J. E. T.

Felling Trees by Machinery.—Mr. James Hamilton, of this city, the inventor of a machine for *sawing* and *boring* for mechanical and other purposes, and for which he obtained a patent as well in England, Ireland, Scotland, and France, as in the United States, has recently invented a machine for *felling trees* in the forest, in which he has succeeded even beyond his most sanguine anticipations; and which will, I have no doubt, prove a valuable labor-saving machine to the settlers of new



References—A, principal wheel, to which the power is applied; B, perpendicular shaft; C, rod connecting the saw with crank shaft; D, pivot on which the saw vibrates; E, frame, revolving on perpendicular shaft, which supports the saw; G, small roller, between the saw frame and the front sill of the machine, to support and keep the saw level

countries, and even where it is partially settled.

This machine requires very little more space for use, than is required to swing an axe; and it may be used in almost any situation where a man can use an axe. It may be moved by one man, from tree to tree, with great facility, (although two men will work it to better advantage,) who can cut a tree of 20 to 24 inches diameter in five minutes, and larger ones in proportion. The machine is so constructed as to admit the use of a saw of 3, 4, 6, or even 9 feet in length, according to the size of the tree.

Such is the construction of the machine, and it may be considered as one of its peculiar qualities, that the more rapid its motion, the less power is required to keep it in motion—or, in other words, by the use of a horizontal fly-wheel, which is placed near the ground-sills of the frame, the machine may be made to perform 250 to 300 strokes per minute, each of which shall cut upon an average at least 1-20th of an inch, or at the rate of 8 to 12 inches per minute, on an ordinary sized tree—thereby producing great execution with very little labor.

The simplicity of this machine is such that there is little danger of its getting out of order; and ample means are provided to prevent accidents from the falling of the trees.

However great may be the advantage of this machine for ordinary use, or for clearing of land for cultivation, in the saving of time, it will be found even more valuable for the purpose of cutting trees for timber; as it will always leave a square and uninjured butt, and save the labor and loss of timber; which always results from squaring the end when chopped in the usual mode. In cutting mahogany trees especially, the most valuable part of which is near the root, it will be found of great value. Mr Hamilton is certainly entitled to much credit for his efforts to facilitate this, the first and most laborious part of the husbandman's labors. None but those who have had experience can appreciate the toil of this labor in a new country; none therefore but such, and

not even those until they have used it, can appr[illegible]ciate the va[illegible] of this invention. In order, however, to give the readers of the Magazine a better idea than they can derive from any written description, a representation, a perspective view of the machine, is given herewith, from which, although accompanied by but few references, any person familiar with machinery will readily understand its operation.

Annexed we give the report of a Committee of the American Institute of this city, showing the estimation in which it is held by that body.

We shall take occasion hereafter again to refer to this machine, and shall take pleasure in recording its performances for the benefit of both the public and the patentee, who deserves well of his countrymen for his inventions of labor-saving machinery.

AMERICAN INSTITUTE, Clinton Hall,
City of N. York, June 25, 1835.

The Committee to whom was referred the improved Machine, invented by Mr. James Hamilton, of this City, for felling trees, report:

That this invention of Mr. Hamilton is one of great public utility, not only in clearing land of trees, but in felling timber trees for naval and civil architecture.

It cuts the stumps uniformly of an equal height, and at least 12 or 16 inches closer to the ground than is usual, the stumps being left with a horizontal surface; having been cut with a saw, and absorbing more moisture than when cut with the axe, the stumps will decay much faster.

Much of the most valuable part of the timber also is saved in cutting close to the ground, and the end of the timber is square when felled, thus saving the additional time and trouble necessary, in the ordinary way of felling, to prepare it for the mill by butting.

The Machine is simple in its construction, and may be worked by one or two men. It can be built for about $50. *It is believed that two men may fell by this machine as much in a given time as twenty can by the ordinary way.* Sufficient provisions are made to prevent the tree from falling on the machine, and to prevent the saw from being pinched.

A tree of 2 feet diameter can be cut with it in five minutes by the power of one man, and with a saw proportionally l[illegible] proportionally larger, trees of any magnitude may be cut with ease. This Machine is about three feet wide and four feet long, and is easily moved from tree to tree, as it runs on small wheels.

Your Committee consider this Machine worthy of being mentioned with commendation to the Government of the United States, and to all persons who have occasion to fell trees, either for clearing of land, or for timber.

GEORGE SULLIVAN, }
ROBERT NEWELL, } Committee.
JAMES F. KENNEY, }

I certify that the report, of which the above is a true copy, was adopted at a meeting of the American Institute, June 25, 1835.

EDWIN WILLIAMS, Rec. Sec.

MODE OF PRESERVING MILK FOR LONG VOYAGES.—Sir: As the season of the year is now arrived when hundreds of mechanics are induced to cross the Atlantic, in the hope of bettering their fortune, and to those who may carry young families with them, milk may be an important article of diet, perhaps the following extract from an old newspaper of the date of 1822, setting forth a simple and easy method of preserving it, may be of importance; more particularly as I perceive from your last monthly list of new patents, that a method of preserving animal milk has just been patented—whether the same or a different method remains to be seen:

"Provide a quantity of pint or quart bottles (new ones are perhaps best;) they must be perfectly sweet and clean, and very dry before they are made use of. Instead of drawing the milk from the cow into the pail as usual, it is to be milked into the bottles. As soon as any of them are filled sufficiently, they should be immediately well corked with the very best cork, in order to keep out the external air, and fastened tight with packthread or wire, as the corks in bottles which contain cider generally are. Then, on the bottom of an iron or copper boiler, spread a little straw; on that lay a row of the bottles filled with milk, with some straw between each, to prevent them from breaking, and so on alternately until the boiler has a sufficient quantity in; then fill it up with cold water. Heat the water gradually until it begins to boil, and as soon as that is perceivable draw the fire. The bottles must remain undisturbed in the boiler until they are quite cool. Then take them out, and afterwards pack them in hampers, either with straw or sawdust, and stow them in the coolest part of the ship. Milk preserved in this way has been taken to the West Indies and back, and at the end of that time was as sweet as when first drawn from the cow."

I am, Sir, yours, J. ELLIOTT.
March 20, 1835.

[From Transactions of the Essex Agricultural Society.]

ON COLORING.

The art of fixing on cloths beautiful colors, although not one of the most necessary, has been made by the fashions, taste, and pride of men, in all ages and nations, one of the most valued of inventions. It is altogether a chemical art. Its theory is now well understood, and is in a high degree interesting to every studious mind, useful to all engaged in manufacturing, or in buying, selling, or consuming colored fabrics. It is, therefore, worthy the attention of all our readers.

Colors, to be permanent, must be combined with the fibres of the silk, wool, cotton, or linen, of which the cloth is composed. To understand how this can be effected, we must acquaint ourselves with the laws of chemical affinity. Affinity is nothing more than the disposition or tendency which two or more substances have to unite and form a new compound, differing greatly in some of its qualities from the simple substances of which it is composed; one substance is therefore said to have an affinity for another when, on being brought in contact, it unites with and assumes new appearances and qualities. For example, if iron and sulphuric acid (oil of vitriol) be brought together, they gradually unite and form sulphate of iron (green vitriol or copperas), but the sulphuric acid has a stronger affinity for lime than it has for iron; if, therefore, lime be brought into contact with sulphate of iron, the sulphuric acid quits the iron, seizes on the lime, and forms sulphate of lime (plaster of Paris.) Substances used in dyeing possess an affinity for the fibres of the cloth, and when dissolved in water or some other liquid, and brought into contact, they unite, and change either the color of the fibres, or so change their qualities, as to dispose them to unite with other coloring matter for which before they had no affinity.

The art of dyeing, then, consists in combining a certain coloring matter with the fibres of the cloth. This process cannot be well performed unless the dye-stuff be dissolved in some liquid, and the particles so separated that their attraction for each other becomes weaker than the attraction for them exerted by the cloth. When the cloth is dipped into this solution, it attracts the coloring matter, and from its stronger affinity takes it from the solvent and fixes it upon itself. The facility with which cloth imbibes a dye, depends on two circumstances, namely, the affinity between the cloth and the dye-stuff, and the affinity between the dye-stuff and its solvent. It is of importance to preserve a due proportion between these two affinities, as upon that proportion much of the accuracy of dyeing depends. If the affinity between the coloring matter and the cloth be too great, compared with the affinity between the coloring matter and the solvent, the cloth will take the dye too rapidly, and it will be scarcely possible to prevent its color from being unequal. On the other hand, if the affinity between the coloring matter and the solvent be too great, compared with that between the coloring matter and the cloth, it will either not take the color at all, or take it very faintly. Wool has the strongest affinity for most coloring matter, silk the next strongest, cotton a much weaker affinity, and linen the weakest of all. In order, therefore, to dye cotton or linen, the dye-stuff should, in many cases, be dissolved in a liquid for which it has a weaker affinity than for the solvent employed in dyeing wool or silk. Thus we may use iron dissolved in sulphuric acid to dye wool, but for cotton and linen it is better dissolved in vinegar. Was it possible to obtain a sufficient variety of coloring matters having a strong affinity for cloth, the art of dyeing would be exceedingly simple and easy. But this is by no means the case; if we except indigo, the dyer is scarcely possessed of a dye-stuff which yields of itself a good color, sufficiently permanent to deserve the name of a dye. To obviate this difficulty, some substance must be employed which has a strong affinity both for the cloth and the coloring matter. Substances employed for this purpose are called mordants. Those chiefly used are earth, or metals, in the form of salts or in solution, tan, and oil.

One of the most frequently used is alum. This salt is composed of pure clay (alumina) dissolved in sulphuric acid. Into a solution of alum the cloth is dipped: the fibre of the cloth having a stronger affinity for the clay than the sulphuric acid has, unites permanently with it. It is then taken out, washed and dried, and will be found a good deal heavier than before, although the color remains the same, the clay, which now forms a part of it, being perfectly white. The cloth may now be dyed by dipping it in a solution of any coloring matter for which the clay has a strong affinity. The clay and coloring matter may be united previous to the immersion of the cloth, and the fibres will still unite themselves with the compound, but not so equally and permanently as when dipped into each of the solutions separately. But the sulphuric acid has rather too strong an affinity for the clay to yield it readily even to wool. Most dyers, therefore, add to the solution of alum a quantity of tartar. Tartar is composed of potash and an acid found in grapes and some other vegetables, called tartaric acid.

When solutions of alum and tartar are mixed, the sulphuric acid quits the clay and seizes on the potash, dislodging at the same time the tartaric acid, which seizes in turn on the clay just abandoned by the sulphuric acid. The tartaric acid, having a weaker affinity for the clay than the sulphuric acid possesses, yields it more readily to the cloth. Another purpose is also gained: he sulphuric acid remains combined with he potash, and this corrosive substance is hereby prevented from injuring the texture of the cloth. For cotton and linen, which have a weaker affinity to clay than wool or silk, another process becomes necessary. Lead or lime dissolved in acetic acid (vinegar) is poured into the solution of alum. A solution of sugar of lead is frequently used. The sulphuric acid quits the clay and seizes on the lead or lime, both of which, united with this acid, form insoluble powders, which fall to the bottom, and the acetic acid unites with the clay, for which it possesses only a weak affinity, and readily yields it to the cotton or linen immersed in it.

Metallic salts may also be used as mordants. Those of iron and tin are extensively used in dyeing. Iron is used as a mordant in two states, in that of sulphate of iron, (copperas,) or acetate of iron, that is, iron dissolved in vinegar or in the acid obtained by distilling wood (pyroligneous acid.)

Tin is used as a mordant in three states—dissolved in nitro-muriatic acid, (a mixture of the acids obtained from saltpetre and from common salt,) in acetous acid, and in a mixture of sulphuric and muriatic acids. The nitro-muriate of tin is the common mordant employed by dyers. It is prepared in the following manner: Melt block tin and pour it into water briskly agitated with a bundle of small rods, take of this granulated tin 2 oz., nitric acid 1 lb., water ½ lb., common salt or sal ammoniac 2 oz., mix them together in a glass vessel, and the tin will be slowly dissolved.* When nitro-muriate of tin is to be used as a mordant, it is dissolved in a large quantity of water, and the cloth is dipped in the solution until sufficiently saturated. It is then taken out, washed, and dried. Tartar is usually dissolved in the water along with the nitro-muriate of tin. This changes the compound into a solution of the tartrate of tin and nitro-muriate of potash. The tartrate of tin is again decomposed by the cloth. The metal quits the acid and attaches itself to the fibres of the cloth, and in this state possesses a strong affinity for coloring matters, and forms with them the most permanent and brilliant dyes.

Tan is also employed, along with other mordants. It is found in nutgalls, oak and hemlock barks, sumach, and in a great variety of other vegetables. It is that part of barks, &c. which has a strong affinity for glue, of which hides are chiefly composed, unites with it and forms leather. It has a strong affinity also for cloth and for several coloring matters. Silk is capable of absorbing a very great proportion of tan, and thereby acquires a great increase of weight. For this purpose alone it is sometimes employed by silk manufactures. Tan is often employed, also, along with other mordants, in order to produce a compound mordant. Oil is also used for the same purpose, in dyeing cotton and linen.

Besides these mordants there are several other substances frequently used as auxiliaries, either to facilitate the combination of the mordant with the cloth, or to alter the shade of color; the chief of these are tartar, sugar of lead, common salt, sal ammoniac, sulphate of copper, (blue vitriol,) acetate of copper, &c.

Mordants not only render the dye permanent, but have also considerable influence on the color produced. The same coloring matter produces very different dyes, according as the mordant is changed. Cochineal, with salts of iron, produces black,—with salts of tin, scarlet,—and with alum, crimson. In dyeing, then, it is not only necessary to procure a mordant which has a sufficiently strong affinity for the coloring matter and the cloth, and a coloring matter which possesses the wished-for color in perfection, but we must procure a mordant and a coloring matter which, when combined together, shall produce the wished for color in perfection.

The colors denominated by dyers simple, because they are the foundation of all their other processes, are four, viz. blue, yellow, red, and black. A few simple directions for dyeing wool, silk, and cotton, of these colors, will now be given. We write for prudent and economical housewives, silk culturists, and agricultural manufacturers, and the means within the reach of such must therefore be kept continually in view, in all the operations recommended.

Blue.—Indigo is the only substance that can be economically used in families for coloring blue. The best or purest indigo is

* When common salt, which is composed of muriatic acid and soda, or sal ammoniac, composed of the same acid and ammonia, is mixed with diluted nitric acid, a part of the nitric acid seizes on the soda or ammonia, and sets at liberty a part of the muriatic acid, which mixing with the remaining nitric acid, forms nitro-muriatic acid, (aqua regia,) which readily dissolves tin, gold, &c. It is more economical, however, to add sulphuric acid enough to saturate the base of the salt, which sets all the muriatic acid at liberty, and leaves the nitric acid undiminished.

light, easily powdered, tasteless, almost destitute of smell, and breaks smoothly, that is, with smooth surfaces. Some will float on water, and this is generally the purest. The color of indigo also varies. There is the blue, the violet, and copper colored. Although these may all contain nearly the same quantity of coloring matter, yet they are differently valued, the blue selling 20 per cent. higher than the violet, and from 40 to 80 per cent. more than the copper colored. The blue is preferred by dyers for combination, or solution in sulphuric acid, and the copper colored for the indigo vat, in which it is dissolved in a potash ley, aided by bran, madder, or other vegetable products, in a state of fermentation. Before indigo can be applied and fixed upon the fibre of cloth, it must be dissolved in water. But it cannot be dissolved in water in its blue state; it must be converted to a green or yellow color, and then it readily dissolves, is attracted by the fibres of the cloth, becomes permanently combined with them, and on being exposed to the air becomes again blue. In the solution of the indigo, therefore, consists the whole art of coloring blue. The following are among the most easy and simple methods of dissolving indigo, or, in other words, forming a blue dye.

First Method.—Take indigo, well powdered, one ounce; quick lime, one ounce; potash, two ounces; copperas, two ounces; molasses, half a pint; warm water, one gallon. Mix, and stir occasionally, keeping the vessel, of copper, iron, or earthen, well covered and in a warm place. The liquor will soon become green, covered with a copper colored or blue scum. In twenty-four hours it will be fit for use. Immerse the stuff to be colored for a longer or shorter time, according to the shade required. The strength of the color may also be varied by using a greater or less quantity of water. A very little practice will enable any one to give wool, silk, or cotton, properly prepared, with this dye, a beautiful and permanent blue, of any shade they may choose.

Second Method — *Saxon Blue.*—In this method, the indigo is dissolved by the aid of sulphuric acid, without losing its blue color, but it undergoes a change which renders it less permanent, and is therefore not much used, except for articles not very durable, or when a deep, unfading tint is not considered of much importance. This preparation is kept in the shops, under the name of *Liquid Blue*, or *Chemical Blue*, and is much used for blueing white cotton and linen garments, from which it is readily washed out, even in cold water. It is also extensively used in coloring greens, giving, with yellow, a more brilliant color than the blue obtained by the first method. On wool and silk it is much more durable than on cotton, and on articles which do not require frequent washing, may be often used advantageously as a blue dye. It is prepared as follows:

Take indigo, well powdered, one ounce; sulphuric acid, four ounces. Mix it in a glass or stone ware vessel, and let it stand twenty-four hours, stirring it occasionally—then add one ounce of dried potash. Let it stand twenty-four hours longer, add half a pint of water, and bottle it up for use.

Mix a wine glass full of this liquid in a pail full of boiling water, and dip the stuffs till they acquire the color desired. More of the liquid must be added when the water becomes nearly clear, before the stuffs have acquired a color sufficiently deep.

Yellow.—There are a great number of imported and native plants, roots and barks, that, by the aid of the mordants alum and tin, dye yellow. But the very best of all these, viz. the yellow oak bark, or quercitron bark, as it has been named in England, being very plenty in this country, it seems altogether unnecessary even to mention any other.

To dye 10 lbs. weight of cloth, or woollen stuffs, of the highest and most beautiful orange yellow, 1 lb. of quercitron bark, and the same weight of murio-sulphate of tin, will be required*; the bark, powdered and tied up in a bag of thin cotton or linen cloth, may be first put into the dyeing vessel, which of course must be brass, copper, glass or earthen, with hot water, for the space of six or eight minutes; then the murio-sulphate of tin may be added, and the mixture well stirred two or three minutes. The cloth, previously wet thoroughly with warm water, may be put in and turned briskly a few minutes; the color applies itself in this way so equally to the cloth, and so quickly, that after the liquor begins to boil, the highest yellow may be produced in less than fifteen minutes, without any danger of its proving uneven.†

* Murio-sulphate of tin. This preparation differs somewhat from the muriate of tin, or nitro-muriate of tin, the method of preparing which is given in a preceding part of this essay. It is prepared as follows: Take six ounces of muriatic acid, and pour it upon about the same weight of tin, granulated as above directed, in a glass vessel. Then pour slowly upon the same four ounces of sulphuric acid, and let it stand in a warm place till the acids saturate themselves with tin, that is, till they will dissolve no more, which will be soon effected, if heat be applied, and gradually without being heated.

† Should a deeper orange tint be desirable, add to the quercitron bark a little madder, perhaps an ounce or less to the pound of bark, according to the color desired. This will greatly increase the beauty of the color, when examined by candle-light.

When a bright golden yellow, approaching less to the orange, is wanted, four ounces of the murio-sulphate of tin, and two ounces of alum, and one pound of bark, managed in the same manner as above directed. Pure bright yellows, of less body, may be colored by employing smaller portions of the articles above mentioned.

A good yellow may also be produced by boiling the cloth for one hour in one seventh of its weight of alum dissolved in a suitable quantity of water, and then, without being rinsed, put it into a dyeing vessel with clean hot water, and about as much quercitron bark, tied up in a bag, as was used of alum. Boil and turn it as usual, until it takes sufficient color, then dip it in warm lime water for ten minutes, and rinse it well immediately afterwards. Tin, however dissolved, when used in coloring wool or silk, renders the fibres a little harsh; but this may be in a great measure obviated by employing the murio-sulphate of tin with a mixture of alum, or alum and tartar, and combining these with the coloring particles of the bark before they are applied to the stuffs.

In dyeing silks, more alum and less tin should be used than is directed for woollens, because tin, unless used sparingly, always diminishes the glossiness of the silk.

To produce a lively yellow on silks, it will be sufficient to boil after the rate of four ounces of bark, three ounces of alum, and two ounces of the murio-sulphate of tin, with a suitable quantity of water, for ten or fifteen minutes, and the heat of the liquor being reduced so that the hand can bear it, the silk is to be put in and dyed, as usual, taking care to agitate the liquor continually, that the coloring matter may not subside until it has acquired the proper shade. By adding very small proportions of *cochineal* to the bark, the color may be raised to a beautiful orange, or even aurora. A similar effect, though less brilliant and beautiful, is produced by adding madder to the quercitron.

A Yellow on Cotton and Linen. — It has been said that the fibres of cotton and linen have not so strong an affinity for clay and tin as those of wool and silk. A somewhat different management, therefore, becomes necessary in coloring the former goods, from that which is required for the latter. The fibres of linen or cotton are prepared for dyeing by being first boiled in water, with a portion of potash, and afterwards bleached. It should then be soaked in water soured with sulphuric acid, to dissolve and remove all earthy matter, and be then thoroughly rinsed, to free it from the acid. Alum, and not tin, must be used as the mordant, for although tin gives yellows exceeding all others in lustre and beauty, on cotton, they decay very speedily when exposed to the sun and air.

For 1 lb. of cotton and linen yarn, or cloth, take alum 3 ounces, sugar of lead 1 ounce—dissolve them in one gallon of water, about blood warm, and soak the stuff two hours; take it out, moderately squeeze or wring it, let it then be dried, and then soaked again in the solution of alum, squeezed and dried as before; then let it be thoroughly washed in lime water and dried as before. Let it then be well rinsed and put into a kettle of cold water with three ounces of quercitron bark tied up in a bag; stirring it frequently, gradually raise the water to a boiling heat; let it boil a few minutes only, as longer boiling would injure the color, and take it out, rinse and dry as usual. It has been found that by immersing cotton a great number of times, alternately in the solution of alum and lime water, and drying after each immersion, the color acquires greater body and durability. The reason of this seems to be found in the shrinking of the aluminous basis (the clay) in drying, and thereby making room for an additional quantity to penetrate the fibre after each drying; and the larger the quantity of this substance united or incorporated with the cotton, the deeper and more durable will be the color fixed upon it.

There are other methods of preparing cotton, so that it will take a sufficient quantity of the clay, from alum, without the use of the sugar of lead, and which are, consequently, somewhat cheaper than the one described above.

Take of the roots of our common sumach, (rhus glabrum,) dried and chipped, one pound, sal soda four ounces, or barilla half a pound, which is an impure soda used by manufacturers of hard soap, and in two or three gallons of soft water boil them for one hour, and then strain off the liquor and steep the cotton therein for two or three hours. Take it out of this liquor, and steep it for the same length of time in a mixture of warm water and fresh cow dung; rinse it out and dry it. Dissolve three ounces of alum in one gallon of water, soak the cotton in this and lime water alternately, and dye it slowly with the quercitron bark as before directed. By the addition of madder, the yellow may be raised to orange, &c.

Woollen, silk, or cotton goods, colored yellow as directed, may be immersed in the saxon blue dye, (second method,) and made to take any shade of green which may be desired.

Red. *Crimson, on Wool or Silk.*—Provide yourself with the following articles:

alum ½ lb., cream of tartar ½ lb., Nicaragua wood 1½ lbs. Dissolve the alum and tartar in four pails of water, in a brass or copper kettle; when boiling, put in the cloth, yarn, &c., and continue the boiling two hours, then take it out and cool and wash it. Fill the kettle again with water, put in the Nicaragua wood tied up in a bag, put in the cloth and boil one hour, take it out and wash it, and if you wish to change the color to crimson, add one ounce or more of pearlash to the liquor, and boil again for fifteen minutes.

Madder Red.—Soak the cloth, &c. as directed in the last receipt, then, instead of the Nicaragua wood, put into four pails full of water, 1½ lbs. of madder and ½ lb. of the nitro-muriate of tin, and when blood warm put in the cloth and turn it continually till it boils, take it out immediately and dip it into lime water, and turn it for a few minutes without boiling, take it out and wash it, &c. The quantity of dye-stuffs mentioned in these receipts are calculated for about 2½ lbs. of woollen goods.

Scarlet.—Firstly, color as directed for the most brilliant yellow, then take one ounce of powdered cochineal for every pound of cloth, and put it into the yellow dye from which the cloth has been just taken, or into a suitable quantity of clean water, with one ounce of murio-sulphate of tin. Put in the cloth, and boil it for fifteen or twenty minutes, wash and dry as usual.

To color cotton red, with Brazil or red-wood, Nicaragua wood or madder, it must be soaked in alum water, and otherwise managed as directed for yellow, the red wood, &c. being used instead of the quercitron bark.

(*To be continued.*)

New Machine for cleaning Hemp.—It has long been a great desideratum in the manufactures of this country to discover the means of extracting the glutinous matter from hemp, and to reduce this article to a *fine fibre*, suitable to the same purposes as flax. This useful object has been generally supposed attainable, though many unsuccessful experiments had been made; but we are happy to announce, that it has at last been accomplished. Mr. Alexander Shanks, junior, flax-spinner, Arbroath, an ingenious mechanic, after considerable application, has invented a machine, composed of two metal plates of a peculiar construction, supported by springs to modulate the compressure; and the hemp in passing through these plates undergoes a friction from the action of the plates, and after passing through several rollers, it leaves the machine free of the glutinous matter, and of a soft delicate fibre. When thus prepared, and heckled, it is equal to the finest flax, and may be spun and applied to the same purposes as the last mentioned commodity. The expense attending the process of preparation is very trifling, the machine being moved by steam power (which may be borrowed from any work where there is a steam engine), and a boy may attend and feed the machine in its operations. The quantity of prepared hemp produced will of course depend upon the size of the machine. It may be mentioned, that the machine is so contrived that the friction does not cut or injure the fibre, but simply removes the glutinous matter adhering to the hemp in its original state, and reduces it to a fine soft fibre. When we consider that the price of hemp is only about half that of flax, and that the prepared hemp is equal, and for some purposes superior, to flax, the great usefulness of this invention must be manifest. We understand Mr. Shanks has secured the benefit of his useful discovery by patent, and from all that we have learned, it will be of great public advantage.

We understand that Mr. Daniel Duff, of this place, introduced a similar mode of preparing hemp, which has been practised here for a considerable time, and has been found to answer the purpose very well. We are not aware of what may be the additional advantages attending Mr. Shanks' plan, that have entitled him to take out a patent for what he deems a discovery.

After we had written the above, a gentleman called at this office with a sample of prepared hemp; which, he assures us, is superior to that prepared either by Mr. Duff or Shanks. It is manufactured by Mr. J. G. Norrie, who has bestowed no little time and trouble on the invention of his apparatus, and the article is pronounced, by judges, equal in appearance to the finest flax. This discovery has created considerable interest among the merchants and manufacturers in our town and neighborhood for some time past; and many persons have been making experiments to attain the desired object. Candor, however, compels us to state, that many of our manufacturers are of opinion, that hemp prepared in this manner loses in strength what it appears to have gained in apparent fineness of fibre.—[Dundee Courier.]

Suspension Bridges.—At a meeting of the Clinton Suspension Bridge Committee last week, Mr. West's report on the principle of wire suspension bridges was read and approved. This gentleman has recently been examining the suspension bridges of France and Switzerland, most

of which are of wire. He stated that previously to the opening of the Fribourg bridge, in October last, proof was made of its capability of sustaining great weight, by placing 36 horses, 14 pieces of artillery, and 300 people upon it at one time, which did not cause the slightest derangement in the structure. Upon the occasion of opening the bridge, a grand procession of the clergy and municipal authorities took place, when no less than 1,800 persons, estimated at 90 tons, were at once on the bridge. The two largest bridges over the Soane, at Lyons, are of wire, and are crossed by the heavy French diligences, weighing 5,000 lbs. each, and allowed by law to carry 6,000 more.—[English paper.]

[From the Journal of the Franklin Institute.]

Notice of the Sandy and Beaver and the Mahoning Canal.

Two companies have been chartered by the Legislatures of Ohio and Pennsylvania, to construct canals to connect the western termination of Pennsylvania with the Ohio and Erie canal. A charter for the Mahoning, or northern route, was first obtained; subsequently, a charter for the southern, or Sandy and Beaver route, was granted.

The Sandy and Beaver route commences at the mouth of the Big Beaver, twenty-eight miles below Pittsburg, and continues down the north flats of the Ohio river, to Little Beaver creek; thence it occupies the valley of that stream, till it reaches the town of New-Lisbon, a short distance north of which it ascends, by a narrow ravine, to the dividing ridge between the waters of the Beaver and Sandy; aftercrossing which, it continues along the valley of the Sandy, and gradually descends to its mouth, near which it intersects with the Ohio and Erie canal, at Bolivar.

The route is ninety miles in extent, and is located through an extremely rich and fertile country; the summit occupies the dividing ridge between New-Lisbon and a point west of the town of Hanover, a distance of fourteen miles; it receives the drainage of eighty square miles of country, and is to be supplied with water from Cold Run, Brush Run, and west fork of Little Beaver creek, Sandy creek, Holland's creek, Mendenhall's run, and Davis' branch; in addition to which, the head waters of the Mahoning can be conducted into it by means of a short feeder. These streams, at their minimum, afford sufficient water for the transit of seventeen boats per day, and, during nine months of the year, an average flow of 2,570 cubic feet of water per minute: an amount adequate to accommodate a trade of 295 boats per day; in addition to this, it is proposed to erect reservoirs, from time to time, as the business may require. Many eligible sites for this purpose are to be found contiguous to the line, four of which have been surveyed, and found to have capacity to contain 280,000,000 cubic feet of water, and would inundate 726 acres of land.

The work is to be constructed of the same dimensions as the Pennsylvania and Ohio canals; the locks, aqueducts, and bridge abutments, are to be formed of sand-stone, and are intended to be of the most permanent character; the country through which the route is located affords materials for the construction of the work, such as stone, timber, and hydraulic lime, of the best description, and in the greatest abundance; the cost of the whole work, including reservoirs, is estimated at $1,289,000.

The Governor of Ohio, in his last annual message, mentions the Sandy and Beaver canal in the following favorable manner: "Viewing a communication between the Pennsylvania and Ohio canals to be a subject of great interest, it is with peculiar satisfaction I communicate to you the intelligence, that the Sandy and Beaver canal company was organized during the last summer, under the liberal provision of the original charter, and the munificent grant of the legislature, in an amendatory act of the last session." "By the report of two able and experienced engineers, all doubts have been removed from the public mind, as to the supply of water on the summit, and is conclusive as to the question of an abundant supply of water for all the demands of an extensive commerce." "Such a connexion has long been a desideratum to the people of the interior and southern parts of Ohio, as it will open to them a new and short route to the eastern markets for their abundant produce, and will enable eastern and western merchants to transport goods from the east at a much earlier period of the spring than by the New-York canal."

The Mahoning, or northern route, commences at the village of Akron, on the Ohio and Erie canal, and from thence extends, in an easterly direction, to the Little Cuyahoga, at Middlebury; "from which it pursues a north-easterly course, until it approaches near the main Cuyahoga, in the township of Stow; thence continuing the same general direction along the south and south-east bank of that river, until it passes the village of Franklin, it enters the valley of the Breakneck creek, and passing up that valley in an easterly course, it crosses the summit between the waters of the Cuyahoga and Mahoning branch of the Big Beaver, near the village of Ravenna. The line then descends rapidly into the valley of the west branch of the Mahoning, crosses that

stream near its south-westerly bend, continues along its north bank, recrossing that branch, and also the south, or main branch, a mile above the junction of those streams; then leaving the river, the line pursues an easterly course, again approaching the river opposite the village of Warren," and then continues along the valley of the river, in a south-easterly direction, to the Big Beaver; thence it follows the valley of the Big Beaver, and connects with the Ohio at the town of Beaver. The whole distance from Akron to the Ohio, by this route, is about one hundred and twelve miles.

The canal commissioners of the state of Ohio, in their report on this route, propose to supply the summit level with water by the following means.

1st. By a feeder from Breakneck creek. This stream, they state, may be introduced by a feeder three miles and six chains in length, and is sufficient for the supply of the summit level, and the contiguous levels, in ordinary seasons, during more than half the year. In the dryest seasons, when the flow of water is reduced to the least quantity, it yields about 240 cubic feet per minute.

2d. By forming reservoirs of four lakes, or ponds, situated near the summit. These bodies of water, Muddy Pond, Sandy Pond, Brady's Lake, and Lake Pippin, may, they state, be converted into valuable and convenient reservoirs, for the supply of the summit, and the adjacent levels; the two former will contain an area of about 240 acres. Water to the depth of twenty feet, or even more, may be accumulated in these ponds, and conducted into the canal, by means of a feeder, seventy-eight chains in length. A depth of eight or ten feet of water on the area of Brady's Lake, and Lake Pippin, may be made available to supply the canal in dry seasons.

It is computed that 825,000,000 cubic feet of water may be reserved for use in these reservoirs.

It will be perceived by the foregoing description—deduced from the reports of Maj. Douglass, Col. Kearney, E. H. Gill, H. Hage, and Col. Dodge, the engineers that examined the routes—that the summit of each canal has to rely on reservoirs, during a period of drought, for a supply of water. By an examination of their respective charters, it will be found that the stockholders of the northern, or Mahoning route, are permitted to receive but ten per cent. on the cost of the work in tolls, while the Sandy and Beaver canal company are allowed twenty; in addition to which, it has received from the Legislature of Ohio the following very liberal grant, which alone, in a very few years, will much more than repay the cost of the work.

"That when the canal authorised to be constructed by the act, entitled an act to incorporate the Sandy and Beaver Canal Company, shall have been completed twenty miles from the Ohio canal, said company shall be entitled to collect and receive the tolls accruing on the Ohio canal, on all freight and passengers that may be transported thereon, and which have been transported not less than twenty miles on said Sandy and Beaver canal, to the Ohio canal; and to receive the toll on all freight and passengers that may be transported thereon, and discharged and landed in said Sandy and Beaver canal, at any point not less than twenty miles from the Ohio canal, for the term of seven years from and after the completion of the twenty miles of canal aforesaid."

Viewing the two routes in point of accommodation to the trade of the west and south-west, embracing the states of Kentucky, Indiana, Illinois, Missouri, and the most fertile portion of Ohio, it will be observed that, by the Sandy and Beaver route, the distance to Pittsburg, or Philadelphia, is sixty-five miles less than by the Mahoning, or northern route.

The western termination of the Sandy and Beaver canal is in 40° 36′, north latitude; Pittsburg, 40° 28′; and Philadelphia, in 39° 57′. Hence, it will be perceived that the three places are nearly in a direct line. These facts portray, in the strongest light, the merits and advantages possessed by this route over any other, and that it is the most direct and desirable continuation of the Pennsylvania canal. From the western termination of the Sandy and Beaver canal, at Bolivar, the distance by the Ohio canal, Lake Erie, the New-York canal, and Hudson river, to the city of New-York, is 780 miles; and by the Sandy and Beaver route, and Pennsylvania improvements, to Philadelphia, 511: making a difference between these two communications to the sea-board, of 269 miles. In addition to this very decided advantage in distance in favor of the Pennsylvania and Ohio communication, is to be added safety, economy, and despatch, and the long periods in spring and autumn which it could be used, when the lake route would be obstructed by ice, or hazardous, as is often the case, by storms.

The immense commerce that the Sandy and Beaver connection will secure to our market cannot at present be approached, even by conjecture. If we view the vast extent of rapidly improving country, where cities and towns are springing up as if by magic, two-thirds of the rich products of which must seek our market through this channel, some distant idea may be formed of the benefits our present chain of internal

improvements, and the city of Philadelphia, are destined to derive from this communication.

As both the northern and southern route have to receive a supply of water, during a dry period, from reservoirs, the following statement may prove interesting.

Letter of E. H. Gill, Esq., Civil Engineer.

Philadelphia, Dec. 29, 1834.

Sir: In conformity with your request, I hand you the following statement, descriptive of the merits of the summit of the Sandy and Beaver canal, compared with the Licking summit of the Ohio canal; the latter, you will perceive from the annexed letter from the present acting canal commissioner of the state of Ohio, Leander Ransom, Esq.,—the general accuracy of which I can vouch for, from my own personal observation,—has thus far been, in a measure, entirely supplied with water by a reservoir; this reservoir covers an extent of about 2,400 acres, and, when full, has a depth of six feet above the plane of the water in the canal, and is said to contain 570,000,000 cubic feet of water; it is located on a stream which, during ordinary seasons, affords a flow of fifty cubic feet per minute, but which, during the latter part of the last summer, was entirely dry. The reservoir receives the drainage of from thirty to forty square miles of country, and, during all portions of the year, it alone has to supply near thirty miles of the summit, and dependent levels, with water, and, during the dry season, about forty-four miles. At the period of my visit to the reservoir, which was during the dryest part of the past season, there was a flow from it into the canal of 1,329 cubic feet per minute, which, at that time, was the only supply received by the summit, and its then dependent levels. The average number of boats then passing was eight per day; to convey which across the summit required at least an expense of twelve locks full of water per day, equal to 112 cubic feet per minute; if to this sum is added one hundred cubic feet per minute, for leakage at the locks, (which were in a very bad condition,) there will be left for evaporation and filtration on the forty-four miles supplied from the reservoir, 1,117 cubic feet per minute, or 25 cubic feet per mile.

This, though I shall, in the following calculations, assume it as datum, is by far too liberal an allowance, because, from measurements and observation, made by me at the time, I found that the upper level, which is nine miles in extent, and through ground of a similar character, to the summit of the Sandy and Beaver canal, but 117 feet per minute were lost by evaporation and filtration, or 13 c. feet per mile per minute.

The minimum natural flow of water into the summit of the Sandy and Beaver canal, during the dryest period of the year, and measured during the past extremely dry season, is 558 cubic feet per minute, (though for nine months of the year it will average 2,570 cubic feet per minute;) the extent of line dependent on this supply is twenty miles, but seven of which, from the peculiarly favorable formation of the soil, and its wet and springy nature, can possibly require any allowance for leakage and evaporation. If, on this seven miles, an allowance for leakage and evaporation of twenty-five cubic feet per mile per minute is made, amounting in the aggregate to 175 feet per minute, there will still be left 383 cubic feet per minute for leakage at the locks, and the purposes of navigation; sufficient to accommodate a trade of thirty-eight boats per day, (the locks having a lift of six feet,) during the dry season, without any aid whatever from reservoirs.

No section of country is, perhaps, more favorably formed, in point of soil and topography, for the construction of numerous and large reservoirs, than that through which the summit of your proposed work is located; during my recent examinations there, sites for four were examined, having capacity to contain 280,640,000 cubic feet of water, and would receive, from actual survey, the drainage of forty-eight square miles of country. Assuming that seventy per cent. of the annual rain that falls, can be collected into reservoirs, which admits of no doubt, being within the limits of the result of actual experiment, and that thirty-six inches in depth of rain falls annually in your latitude, and the above described section of country will afford the reservoirs a supply of 2,810,141,720 cubic feet per annum; in addition to which, the summit drains fifty-two square miles of country, fifty per cent. of which could, if required, be laid up in other reservoirs, making, in the aggregate, 4,985,164,800 cubic feet of water, upon which no demand need be made but in the dry season, or ninety days in the year.

In drawing a comparison between the Licking summit of the Ohio canal, and that of your proposed canal, it will be observed the former has an extent of forty-four miles, which is entirely dependent on the reservoir for water during the dry season; that the natural flow of water into that reservoir is but fifty cubic feet per minute, the drainage about thirty-five square miles, and the maximum depth of the reservoir is but six feet; while the latter has an extent of but twenty miles, to meet the demands of which there is a natural flow, at the driest periods of the year, of

550 cubic feet per minute; in addition to which, numerous reservoirs may be formed as required, varying from ten to thirty feet in depth, and having a surface of eighty square miles, to supply them with water.

The very favorable result afforded by the Licking reservoir may be fully anticipated from the proposed works of a similar character on the summit of the Sandy and Beaver canal; the soil and country are alike, and their proximity to each other renders each alike subject to the effect of the same changes of climate. I cannot think any other evidence than a comparison requisite to satisfy an unbiassed mind, that the supply of water that can be obtained on your proposed canal route is far more than adequate to meet the demands that may be made on it.

But other evidence, if requisite, can be adduced in favor of the firm reliance that can be placed in reservoirs; if we look to France, there we find the Languedoc canal supplied in a great measure from a reservoir; if we refer to England, we find the Rochdale, the Huddersfield, the Nottingham, the Oakham, the Oxford, the Dudley, the Stourbridge, and the Grand Trunk canals, the summits of most of which are entirely supplied with water by reservoirs. In Scotland, they have been found of immense advantage. In our own country, we have, in addition to the Licking and Portage summits of the Ohio canal, which are supplied by reservoirs, the summit of the Chesapeake and Delaware canal, which is, of itself, a large reservoir, and receives but a small portion of constant running water, and the summit of the Union canal. The Schuylkill Navigation Company has, during the late dry season, received great assistance from the reservoir lately erected at the head of their works.

Very respectfully, yours,
E. H. Gill, Civil Engineer.

B. W. Bakewell, Esq.,
One of the Directors of the
Sandy and Beaver Canal.

Extract from a letter from Leander Ransom, Esq., Acting Ohio Canal Commissioner, in relation to the Licking Summit and Reservoir.

"The extent of country drained by the reservoir is between thirty and forty square miles.

"The extent of line supplied in part to the westward of the reservoir is about thirty miles in the driest part of the season; however, the water received from other sources is very inconsiderable, much depending on the duration of the drought. In the driest part of the season, nearly thirty miles to the westward, and fourteen north-east, in all forty-four miles, are supplied from the reservoir.

"The reservoir is supposed to contain, when filled to six feet above top water line of the canal, about 870,000,000 cubic feet of water, about 570,000,000 of which is available, and to cover about 2,400 acres.

"Something of an idea of the expenditure of water from the reservoir for a part of this season, may be formed from the following observations, to wit: On the 25th of June, the water in the reservoir was 4 feet 5 inches above top water line in the canal; July 13th, 4.9 feet; August 27th, 3.9 feet; September 24th, 3 feet. No rain having fallen from July 4th to September 24th."

Mr. Ransom states that the reservoir could have been filled much more, but it was not considered necessary; and the superintendent informed me that it could have been filled in July, had it been deemed requisite. E. H. G.

School of Civil Engineers.—The trustees of Rensselaer Institute met on the 22d May, to receive the statute passed the 9th May, empowering them to organise a school of civil engineers as a branch of the Institute. Regular degrees of Civil Engineer are to be conferred by the President, Rev. Doct. Nott, in October annually, on those who are qualified theoretically and practically, and over 18 years of age. This is the first school of the kind ever organized on this continent. The Royal Military Academy at Woolwich, England, and the Polytechnia, in Paris, have branches nearly similar. Professor Eaton takes the immediate charge of this department; Adj. Prof. Hall having been appointed to take the chief charge of the Natural Sciences. A very spirited corps of 6 or 8 young gentlemen have already entered the division, and will probably offer themselves for the degree of Civil Engineer in October. Two afternoons in each week will be devoted to the application of elementary principles to works in this vicinity, such as railroads, canals, bridges, water-works, mill-works, factories, &c. &c.

The Board of Trustees now consists of the eight appointed members from Albany, Troy, Lansingburgh and Waterford, (two from each,) with the addition made by the late statute of the Mayor, Recorder, and one Alderman, of this city. The list of officers stands thus: Rev. E. Nott, D. D., President; Judge David Buel, Vice President; Hon. George Tibbitts, Hon. J. P. Cushman, William D. Haight, Esq., *ex-officio*; Hon. Jesse Buel, and Philip Van Rensselaer, Esq. of Albany, Hon. J. D. Dickinson, and R. P. Hart, of Troy, are the Prudential Commit-

tee; Elias Parmelee, Esq. and Rev. Phineas L. Whipple, of Lansingburgh, Gen. Guert Van Schoonhoven, and the Hon. John Cramer, of Waterford, constitute the Board of Trustees; Amos Eaton, Senior Professor and Agent, also Acting Professor of Civil Engineering; Ebenezer Emmons, of Williams College, Junior Professor; James Hall, Adjunct to the Junior Professor, and performing the duties of that office. Special Assistants are appointed temporarily. Dr. Moses Hale, Secretary, and H. N. Lockwood, Esq. Treasurer.

The degree of Bachelor of Arts, heretofore conferred on the general graduate, is changed to *Bachelor of Natural Science.* We consider this a good change, as the name is now more appropriate. The degree of Master of Arts is still retained as an honorary diploma for the general graduate, as well as the engineer, after three years of successful improvement in the useful application of his talent. E.—[Troy Daily Whig.]

Modern Fortification.—[In the following article, the reader will discover that the writer has made himself thoroughly acquainted with the subject. Being a practical engineer, in the government service, and in the constant practice of applying those principles which must necessarily make him familiar with the science to which he is devoted, no other recommendation would be required, than the perusal of the essay, to convince any one of the qualifications he possesses over the ordinary class of collaborators upon this particular department of knowledge. While we express our indebtedness to the same talented gentleman for contributions he has in times past made to this publication, we cannot refrain from indulging a hope that he will hereafter embody, in a distinct volume, an elementary work on engineering, so much needed in our country, whose resources will be developed in proportion to the skill, science, and thorough investigations of those who make it their business to defend man against the incursion of his fellow man;—stay the billows of a restless sea, by the construction of walls, and trace out those courses through the hills and the dales, by which intercourse with distant provinces may be accelerated, and convenience and human happiness increased.]

The science of war has always been of deep interest to mankind, and will doubtless continue to be so for ages yet to come. Although war is one of the greatest misfortunes that can befal a nation, whether through its own fault or that of another, still it is one of the evils for which we must be prepared, even as we would prepare to defend ourselves against personal violence, in travelling through a land where no laws could protect us. For though the common consent of men of various countries has sanctioned a code of principles known as the Laws of Nations, these cannot always avail where there is no adequate power to enforce them. Nations as well as individuals may do wrong; but where is the authority to arrest them, or where the court to give sentence? They may be the aggressors, and enter innocent lands with fire and sword, ravaging and plundering; but who will shield the injured party, if it make no effort in its own defence? The hand of Omnipotence, will it be said? No: the deity works by means, and neither nations nor individuals are so innocent in his sight as to be free from the calamities of life, or exoenrated from making any effort to avoid them. Would the advocates of unconditional peace consent to abolish all law in the land, and let the robber and murderer go free? Or, in such a state of things, would he offer no resistance to a personal attack, when there was no law to redress him? Yet such must be his conduct, to be consistent with his principles. Doubtless it is our duty to avoid war as much as in our power, by giving no just cause for complaint on the part of other nations. The great apostle of our Savior says, "If it be possible, as much as in you lieth, be at peace with all men." But this doctrine is evidently different from that of unconditional submission, inasmuch as it implies that there are cases where it is not in our power to be thus at peace, unless by bowing our necks to oppressors, who would cry "peace, peace," when "there is no peace." While, therefore, we rejoice that the more enlightened, just, and humane policy of nations is removing many of the causes of war, we still think it necessary to be always prepared to resist aggression, as the surest way to prevent its being attempted. How far we ought to suffer wrong, before taking arms in offensive war—how great should be the

provocation to justify the first step—is a question which requires the united wisdom of a nation to decide. But to deal so justly and honorably with other nations, that they shall have no *cause* for war, and to present a front so united and defended that they shall not wish to *seek a cause*—this is *our* principle of universal peace, and one which, if universally followed, could not fail to accomplish its object.

These remarks are preliminary to a brief general description of modern Fortification, as one of the most important and effective preparations for war: we do not mean to say, the only one; regarding the construction of ships of war, the preparation of armaments for both ships and forts, the means of furnishing supplies and making communications, and the discipline of the men, as all of equal importance to a successful war. But as the construction of vessels and fortifications requires the longest time among these preparations, so should they be the earliest commenced, and most regularly prosecuted to their completion. It is the present policy of our government, as it long has been, to establish a system of fortifications on our seaboard, especially for the defence of our most important cities and harbors. We deem this a wise and prudent policy, worthy of a great and enlightened nation. We regard the moneys thus expended for national defence, in the light of a premium of insurance to the lives and property thereby protected. The merchant who insures his vessel does not intend that it shall therefore be lost at sea, nor does the citizen, insuring his house, expect thereby to cause its destruction; neither does the building of forts imply a wish to engage in war, or an intention to do so. Far from being the means of bringing on a war, this is the very way to avoid it, by diminishing the chances of success to an enemy.

A fort is a strong enclosure to protect a weaker body of men within it against a stronger body without. Forts are often constructed for the defence of harbors, by firing against the ships of an enemy. If the enemy would always remain on board his ships, a simple water battery would answer every purpose. But as it is presumed that the foe would attempt to land with a stronger force, and take possession of the battery, it becomes necessary to protect the latter by walls in rear, and on each side; so that the water battery becomes one or more of the sides of the fort, which thus forms a complete enclosure.

In a contest between a fleet and a fort, the latter has a manifest advantage, if it be not too low, or if the enemy cannot come too near it when it is low. For the men in the fort being sheltered by the walls, and firing through embrasures, or over high parapets, are very little exposed to the guns of the fleet, and only in imminent danger when the ships can so place themselves that the sharp shooters in their tops may look down upon the men in the fort, and pick them off with their small arms. For this reason, where ships can approach within 300 yards of the fort, the latter should not be less than 60 feet above water, or it would be overlooked. In all other respects the fort has a decided advantage. The men of the fort are but slightly exposed, compared with those of the vessel. The carrying away of the mast, by chain shot or balls, disables the ship, and leaves her almost at the mercy of the enemy, while her fire can seldom dismantle but a very few guns of the fort. The guns on shore admit of a steady and accurate aim, while those on the water, from the progress and rolling of the ship, are comparatively uncertain. And finally, the shot from the vessel recoils almost harmless from the walls of the fort, while the latter can fire red hot shot through the side of the vessel, or at least deep enough to be inaccessible till it can set the wood on fire without its being discovered. By firing low, if the shot strikes the water, (unless the sea is extremely rough,) it will rebound once or more, and still strike the vessel, rigging, or hull. As the guns may be fired with hot shot, and with steady aim, about twice in a minute, we may judge how effectual they must be against a vessel. The fire of the fort, with 24, 32, or 42 pounders, will begin to be effective at the distance of two or three miles; but the ship must approach within 800 yards to make any impression on the walls of the fort, and there she would soon be destroyed. So great is the disparity, therefore, between land and naval batteries, that one gun of

the former has been considered as effective as twenty of the latter. This of course supposes the former to be well constructed, and protected by an earthen parapet.

The excellence of a fort consists in its enabling a few men, shut up within it, to resist the attack of a much greater number, for a certain period of time. From the long experience of sieges, this time may be very nearly calculated for each different project, and forms one method of determining the best among several projects for the same work. For instance: a garrison of 5,000 men, in a regular fortification, should be able to hold out against a besieging army of 100,000 men for at least six weeks, supposing the siege to be regularly and closely pursued. At the end of that time, they would probably be reduced to surrender, unless succored by a relieving army; but the six weeks thus spent by the besieging army should enable an army of relief to arrive, and thus save the fort from a surrender. Some forts are much stronger than others, but none are so strong as to be absolutely impregnable, provided there be sufficient force to attack them. Gibraltar itself might be taken by building a mole or mound as high as the rock, and arming it with a battery as heavy as its own; but considering this to be impossible, Gibraltar is pronounced impregnable. Thus art assists nature in forming a strong hold; and where nature has done the least, art has to do the most. It is in level, open countries, destitute of natural defences, that the art of fortification is felt to be the most valuable.

The object of the fort is to separate the defenders, or garrison within it, from the enemy without, whose strength is thus made unavailing. This is done by means of a high wall, and usually a deep ditch, extending quite around the fort, of which they form a principal part. The ditch varies in different works from 30 to 100 feet in width, and should be too wide to admit of crossing it by ladders or portable bridges. The wall within the ditch is called the *scarp*, and is usually about 30 feet high, so that it cannot be easily scaled, if vigilantly guarded. Instead of a simple circular or polygonal form, the scarp is broken inward on each side, as represented in figure 1, which is the plan of the scarp of a regular fort, with five bastioned fronts. The projecting or salient portions are called the *bastions*, and the re-entering or retired lines connecting them are the *curtains*. The curtain with a half bastion on each side, or rather at each end of it, forms a *bastioned front*, as shown in fig. 2. The straight line, A B, is called the side of the polygon; A*b* the *left face*, *bc* the *left flank*, *cd* the *curtain*, *de* the *right flank*, and *e*B the *right face* of the bastioned front AB. Thus, a bastioned front consists of a curtain, two flanks, and two faces; which being repeated on the different sides of the polygon, form the enclosure of the fort. The object of this configuration may be thus explained: Suppose an enemy to have reached the scarp wall, and to attack the face A*b*, (fig. 1 or 2,) in attempting to enter the fort. The men who are defending this face would not be able to fire down upon the enemy at its foot; and they may be panic-struck, so as to make a weak resistance. But the men on the flank *de*, who are out of danger, can fire upon the enemy along AB with great precision; and *enfilading* them, or sweeping them in line, with grape or canister shot from carronades, would mow them down like grass before the scythe. No attack made under such disadvantage can be successful. In this manner the flank *de* will defend not only the face A*b*, but the flank *bc*, and half the curtain *cd*, or half the bastion front AB. Likewise, the flank *bc* will defend the right half of the front, from the salient B to the middle of the curtain *cd*. Thus the whole perimeter of the scarp is defended by the flanks; and the bastions become a far stronger substitute for the projecting and flanking towers of the ancient castles and walled towns.

Recurring now to fig. 2, we have a plan of the bastioned front AB more in detail. PP is the interior of the fort, called the *parade*; or in fortified cities, it is the space occupied by the city, leaving a narrow space between the buildings and the enclosing fort. The dark space XX is the main *ditch*, immediately outside of the scarp wall, and usually dug much lower than the parade. Between the ditch and the parade is the *rampart*, which forms the enclosure of the fort, and of which the scarp wall forms the exterior face. The rampart is raised

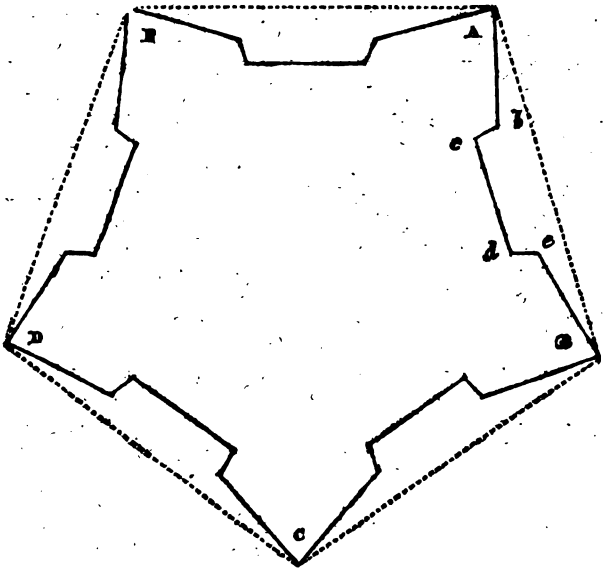


Fig. 1.

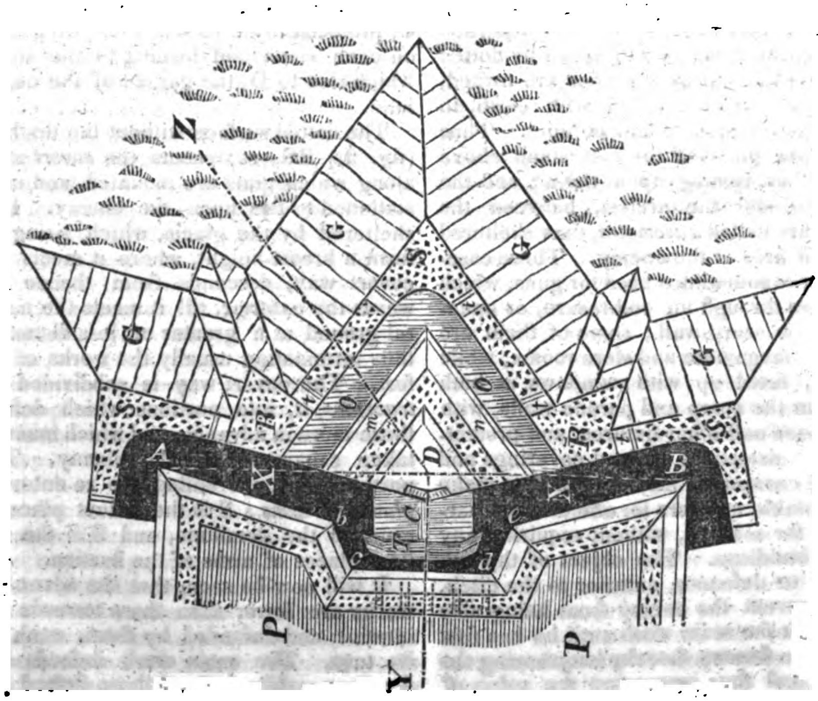


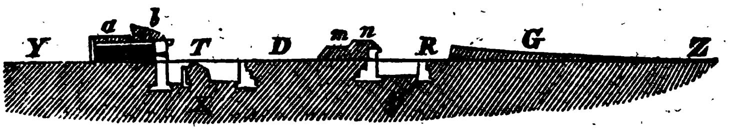
Fig. 2.

much higher than the ditch or parade, so as to protect men, and sometimes buildings in the interior, from being seen or fired on by the enemy. The top of the rampart consists of two parts; the *terre-pleine*, or interior part, (dotted in the figure,) on which the guns are mounted, and the *parapet*, which is the exterior or highest part, to hide the guns and men on the terrepleine from the enemy's fire. The guns on the terrepleine can barely be pointed over the parapet to fire upon the enemy, and sometimes a hollow is made in the parapet opposite each gun, called an *embrasure*, while the highest parts of the parapet, or *merlons*, protect the men between the guns. The rise from the terrepleine to the parapet is called the breast-height; the top of the parapet declining gently outwards, is called the superior slope, and from this the exterior slope descends, usually at an angle of 45°, to the scarp, which is, of course, lower than the top of the earthen parapet. Instead of making the rampart a solid mass of earth, it is customary, in important forts, to construct vaults or rooms in it, to protect the men during a siege. *Piers* are run back from the scarp to the interior of the rampart, which in this case becomes the *parade wall*, and on these piers (shown by dotted lines on the curtain,) arches are turned, which are then covered with earth, to form the terrepleine and parapet. Thus the upper guns of the fort stand above the arches, resting upon them; and the rooms under the arches, between the piers, are called *casemates*, thus sheltered from all fires of the enemy. These casemates are sometimes used for guns, which then fire through an embrasure, or opening in the scarp wall; some of them are used for magazines and store rooms; while others, fitted up with windows at both ends, in the scarp and parade walls, with fireplaces and other fixtures, and protected from dampness by lead coverings and heated currents of air, are found to make comfortable quarters for officers, and barracks for soldiers, without requiring any other buildings. The object of the *outworks*, or defences, exterior to the ditch, is to prevent the enemy from being able to attack the main work until he has first taken the former, thereby lengthening the siege, and thus increasing the value of the fort. The principal of the outworks is the *demilune*, Dmn (fig. 2), called also the *ravelin*, the faces of which, m and n, have an advance and cross fire upon the enemy; while their height is not so great as to mask the fires of the main work, the guns of which can fire over the demilune. Like the main rampart, it has a terrepleine, (dotted in the figure,) on which the guns stand; and outside of it a parapet formed by the breast-height, superior slope and exterior slope, extending down to the wall or scarp of the demilune. The ditch of the demilune, OO, connects usually with the main ditch XX, though the former is not quite so deep as the latter. The inner wall of the ditches being called the scarp, their outer wall is called the *counter-scarp*. The main ditch being widest along the curtain, the scarp is there most exposed; a small work called the *tenaille*, T, is frequently introduced in the ditch, high enough to shelter the scarp from the enemy. Behind the tenaille, and in the middle of the curtain, is the *postern*, or arched gateway, which communicates between the main ditch and the interior main work or body of the place. There is also an arched passage under the tenaille, to the *double caponnier* C, protected by a raised bank or *glacis* on each side; and leading to the stairs which rise to D, the parade of the demilune.

The dotted surface without the ditches, (fig. 2,) RS, represents the *covert way*, along which guns are mounted, and men stationed to fire upon the enemy. It is sheltered by the glacis, which rising to form a breast-height, where it meets the covert way, descends from thence towards the exterior, till it meets the natural ground at a greater or less distance, thus terminating usually the works of the fort. The covert way is subdivided by *traverses*, tt, into portions which defend those more in advance, and which must be taken separately by the enemy. The portions, RR, are called the re-entering *places of arms*; S is the salient place of arms of the demilune, and S S the salient places of arms of the bastion.

It will now be seen, that the advanced works are lower than those towards the interior, and defended by them, each in its turn. The main work defends the demilune, while both of these defend the

Fig. 3.



covert way; and all three can fire upon the glacis at the same time. The advanced works are overlooked, or, in military language, *commanded* by those in rear; and there is no point in or near the fort where an enemy can shelter himself from its fires. The relative *relief*, or height of the works one above another, is shown in fig. 3, which represents a section or vertical cut through the fort, along the imaginary line YZ. Y is the parade; *ab* the rampart, with the parade and scarp walls—*a* the terrepleine, and *b* the parapet; the casemate underneath being in black, the arch over it in white, and the earth above shaded with oblique lines. X is the main ditch, in which is placed the tenaille T. D is the demilune; *m* its terrepleine, and *n* its parapet. O is the ditch of the demilune, R the covert way, G the glacis, and Z the natural ground on the exterior of the fort.

A fortress thus constructed is secure from being taken by storm or surprise, so long as it is vigilantly guarded. The only means of taking it is by the process of a regular siege. We have not time to give a detailed description of all the operations which this requires, both for the attack and defence. Suffice it to say, that the enemy begins by surrounding or *investing* the fort with a large army, protecting himself from the sorties of the garrison by lines of *circumvallation;* and, if necessary, constructing lines of *countervallation* to protect himself from any distant army coming to break his lines and relieve the garrison. Thus the garrison is completely hemmed in, and cut off from all farther supplies of men, ammunition, or provisions, except what it has in the fort. The enemy next advances near the fort on what he supposes to be the weakest side, and there, under cover of the night, digs a trench to shelter his men, called the *first parallel*. This parallel is often more than a mile long, and in a circular line around that side of the fort, six hundred or eight hundred yards distant from it; it being too dangerous to advance nearer at first. Having finished this parallel, a strong guard is placed in it to defend the sappers, who now dig trenches from this parallel, advancing towards the fort, called *boyaux*. These trenches run not directly towards the fort, for then they would be swept or enfiladed by its fires; but they incline for a short distance, a little to the right of the fort, and then a little to the left, in a zig-zag line. When the *boyaux* are extended nearly half way from the first parallel to the fort, a second parallel is dug, to which the guard are then advanced to protect the sappers while they advance still further. In this manner the third or fourth parallel will bring them close to the crest of the glacis, or to the covert way of the fort. Before this time, however, they will have erected batteries to fire against the fort, and destroy or silence its guns. The *ricochet* fires, where the ball, after first striking is made to rebound and strike several times successively, are the most effective for this purpose. The enemy will now, either by sapping or by storm, dig a trench along the crest or top of the glacis, in which to defend himself and erect new batteries to batter down the walls of the fort. This operation is called *crowning the covert way*, as the garrison can no longer hold it, but are obliged to retreat to the demilune. The enemy's batteries will now endeavor to effect a breach in the scarp of both the demilune and the salient of one of the bastions; so that the earth falling down may produce a gentle slope, by which to ascend to storm the fort. Meanwhile a gallery will be constructed, descending from the glacis under the covert way to the foot of the counter-scarp, so that the enemy may enter the ditch thereby, and cross it to the assault. As soon as the demilune is taken, the enemy will shelter himself in it, by digging a trench and throwing up the earth before him for a protection, as in the parallels. At length, the breach in the main work being effected, the enemy will mount to the assault, un-

less the garrison prefer to capitulate and resign the fortress to the besiegers, or unless a relieving army should have arrived to compel the latter to raise the siege.—[Scientific Tracts.]

Prussic Acid for killing Whales.—Mr. Dexter H. Chamberlain, an uncommonly ingenious mechanic of Boston, who some time since produced the machine for manufacturing hooks and eyes with extraordinary exactness and rapidity, has devised a scheme for killing whales, so very novel, and yet, theoretically, so very certain, that it promises to produce an entire revolution in that laborious and truly hazardous employment. It is familiarly known, that after a harpoon is thrust into the great monster of the ocean, he runs till exhausted by the loss of blood; in a word, the boat's crew must wait till he bleeds to death. The sacrifice of life in following a wounded whale, towed as the boat is, by the frightened, wounded, and enraged animal, is sometimes melancholy in the extreme. At any rate, there is a considerable loss of time in this part of the business, and not unfrequently, a total loss of the whale, in consequence of not giving a mortal wound.

To obviate all these difficulties, Mr. Chamberlain has constructed a harpoon upon a new principle, which conveys to the bottom of the incision a small vial of *prussic acid*,—the most deadly of all the known poisons, inasmuch as the vital energies seem to be overthrown very soon after this horrible liquid is brought in contact with the blood. The harpooner, as is customary, will throw the instrument with all his might, without regard to the spot—for his object is to inject the poison. When the whale starts, by re-acting on the line attached to the harpoon, the vial is instantly crushed, and death let loose within his mighty frame. There can be no redemption for the whale—die he must, and that quickly, for he is a warm-blooded animal.

Mr. Chamberlain has secured a patent, we understand, and deserves a generous reward for this unique discovery, which, while it tends to lessen physical suffering, an object of the highest moment to the humanely disposed, affords the most certain success to the operations of the whalemen.—[Ibid.]

[From Porter's Chemistry of the Arts.]

FURNACES IN GENERAL.

The principal and most critical parts of the apparatus subservient to chemistry, being the furnaces employed for the preparation of those substances which come within the chemical class, the structure of these is more complex, and the uses they are applied to of a more nice and difficult nature, by far, than any other of the operations regarding that art. It is, therefore, necessary that they should be well designed, and judiciously executed. Otherwise their defects greatly enhance the expense, and frustrate the intention of the operations they are to perform; besides their being extremely liable to become in a very short time out of repair, and uselessly ruinous.

It is also proper that careful and able men should be employed in the fabrication of furnaces, though such are rarely to be found among common workmen. But the most likely to succeed are those who have either been employed before in the same business, or have been accustomed to set coppers for household purposes. When the best qualified, however, are set to work, they should be continually superintended by the operator, or some person capable of judging, both of their adherence to the plan given and general performance of the work. For if the parts of furnaces that are exposed to much heat be not made extremely compact, but are patched up of mortar and bricks that are not fitted in every part to each other, as bricklayers are very apt to do from the habits they acquire by being employed in coarser buildings, the mortar will very soon calcine, and shrink in such faulty places, and make such vacuities and inlets to the air as render the furnace incapable of doing properly its office, to the great delay, and sometimes destruction, of the process.

The materials are the next object of attention; and they ought to be well chosen, and perfect of their kind. Common bricks, with good mortar, made with lime and coal ashes, well mixed and beaten together, will serve for those parts which are not liable to be heated red hot; but where that degree of heat, or a greater, may happen, Windsor bricks, and Windsor loam, or Stourbridge clay; and where

the fire may be very violent, the composition called the fire lute, hereafter mentioned, should be used. And as the Windsor bricks are of a texture which admits of it, they should be so ground to fit each other, as to form one compact body, with scarcely any interstices at all.*

Particular care should be likewise taken in the drying of furnaces, for the best designed or constructed may be easily spoiled by any mismanagement in this point; and this is very frequently the case. Where the use of them is wanted, as generally happens, before they are ready, they are not allowed a proper time. The interior part should be therefore suffered to settle and dry for some days before the cavity be closed in by finishing the upper; and after that part also is become pretty firm, they should be gradually warmed by a small charcoal fire, made either in the body of the furnace itself, or in the ash-hole under it. After this has been some time continued, and the mortar appears hard in the inward surface, a coal or wood fire may be made, of a gentle degree at first, and increased slowly, as the smoking of the furnace may indicate to be proper. But the more leisurely this proceeds, the more durable and perfect will be the furnace.

Notwithstanding the great importance of commodious furnaces to the practice of chemistry and pharmacy, the methods in general used for their construction are surprisingly defective. Several errors committed with regard to them are here hinted, and on what principle they may be avoided; the remedy however in each case will be reserved, till the improved plan for the construction of the several particular kinds is given.

"The first and most obvious fault is the disposing the fireplace in the front of the furnace, instead of putting it under the centre of the pot intended to be heated; by which means the fire exerts its greatest force on the column of brick over it, calcining and destroying all that part of the furnace, without an equivalent effect on what it is intended to act upon. This improper disposition of the fire may, however, be easily avoided; and a right situation substituted, if the worm flue, improperly used in common, be omitted, and the other methods followed, which are given in the particular plans. And as the inconveniences resulting from this error extend as well to the fire-places of stills and boilers as of other furnaces, an undue consumption of fuel, and quick destruction of the furnace, being always disadvantageous, it will be found beneficial to endeavor to remove them in all cases, especially as it may be done without producing any other incommodious consequence, except where immensely large vessels are in use, which unavoidably require a support of brick-work under them.

"Another great error in the building of furnaces, particularly those for pots or stills, is, as has been hinted, the carrying the fire around the vessel to be heated, in a vermicular flue, or worm, as it is commonly called, by which means the vessel intended to be heated is much longer in attaining a due degree of heat, as the principal force of the fire is exercised upon that great mass of brick-work which forms the worm, and is brought into equal contiguity with the vessel itself, in respect to the fire, with indeed a much greater surface exposed to it; from whence it requires a proportionable quantity of fire to keep the whole in any stated degree of heat.

"Besides the great delay, therefore, in the beginning of the operation, which cannot proceed till the whole mass that makes the worm be brought to a certain heat, the due effect cannot be had, without the consuming a much greater proportion of fuel than if the heated vessel hung in the open furnace.

"But there is yet another momentous inconvenience arising from furnaces of this kind of structure, where a strong heat is wanted, which is, that the brick-work of these worms is extremely subject to be damaged, and fall to pieces, from whence, the flue being choked up, and the draught obstructed, a necessity arises of taking down all that part, if not the whole of the furnace, and rebuilding it at a great expense, as there is no possibility of repairing it under these circumstances.

"An entire open cavity, carried round the pot, still, &c. formed by raising the

* The clay obtained at South Amboy, N. J., answers the best purpose for fire bricks of any that I have met with in this country, but is inferior, I believe, to the Stourbridge clay.—[Am. Editor.]

brick-work, at an equal distance, on every side, and closing it in where no farther heat is required, answers the end much better. It suffers the proper object to be immediately surrounded by the fire, and places it out of the contact of other bodies, so as to be capable of being independently heated; while the furnace itself is much less liable to be damaged, or can sustain a small degree of damage, without any material injury to its use, and even when it is injured so as to require repairing, admits of it with greatly less trouble and expense than when built in the other method."

Principles of constructing Furnaces.—The importance of furnaces in the practice of chemistry is so great that the principles on which they are to be constructed ought to be carefully studied, in order to be able to adapt them to the purpose the artist designs. Furnaces consist of a variety of parts, namely: 1st, the twere, or entrance for air; 2d, a room to receive the ashes of the fuel; 3d, an ash-room entrance, by which the ashes may be extracted; 4th, a grate to support the fuel; 5th, a fire-room, to hold the burning fuel; 6th, a feeding door, by which fresh fuel may be added as often as is necessary; 7th, a stoking door, by which the fuel is managed; 8th, the throat or bridge, by which the flame and heated air are admitted into the laboratory or chamber of the furnace; 9th, the laboratory or chamber, containing the vessels and materials to be acted upon by the fire; 10th, the entrance into or out of the chamber; 11th, the vent by which the flame and heated air passes out of the chamber into the flue of the chimney; and, finally, 12th, the chimney to carry off the heated air and smoke into the atmosphere.

All these twelve parts are not to be found in every furnace, three of them only being essential to the very idea of a furnace; namely, the twere or entrance for air, the fire-room, and the vent.

The Twere.—The twere, or entrance for air, is generally made to open into the ash-room, but sometimes into the fire-room itself. When it is intended to admit the atmospheric air by the unassisted pressure of the latter, as in what are called air furnaces, it should be made as far beneath the level of the grate as the situation will allow. In some cases it is made to open out of a deep vault, or long subterraneous passage, or a hole being cut in the wall of the laboratory, an iron pipe is laid down so as to allow a current of cool air to flow from the outside of the laboratory into the furnace; the outer mouth of this pipe is frequently made conical.

The entrance of the air in air furnaces should in all cases be regulated, or, at least, be capable of being stopped altogether whenever it is judged requisite. Various methods are used for this purpose. The oldest, and, when the twere is not too large, still the best, is merely to heap up ashes against the twere, and to regulate the opening by means of a poker or spatula; at present an iron door is more generally used, which is opened more or less as occasion requires. Some chemists use a series of circular holes, having their diameters in geometric progression, 1, 2, 4, 8, 16, &c., with stoppers fitted to them, as Dr. Black, in his original furnace; others use one or two slides moving in grooves, and there is now sold in London a circular slide invented by Count Rumford.

In general, the entrance for air in air furnaces is made much too large, so that the velocity of the air being diminished, it becomes much heated in its passage, expands, and thus a less weight of it is presented to the fuel. The area of the entrance ought to be regulated by the sum of the areas left open between the bars of the grate, and its area should not exceed two thirds of those open spaces, in order that the air may strike against the grate with some degree of force.

Blast furnaces are those in which a large quantity of air is supplied, by means of mechanical contrivances, than would pass through the fire by the unassisted pressure of the atmosphere. The air is made to enter the furnace by means of one or more pipes leading from the bellows or other blowing machine. In the small blast furnaces used by experimentalists, assayers, and other metallurgic artists, the twere is made no larger than barely to admit the blast pipe, and the crevices, if any are left, are usually stopped with soft clay; but in the large blast furnaces of the iron works this is not the case; and it is said, that even in small blast furnaces there is some advan-

tage in not being solicitous about closing the space between the blast-pipe and the sides of the twere.

The Ash-room.—In regard to the ash-room, no particular observations occur, except that in the small blast furnaces of the French experimental laboratories it is now divided horizontally in two parts by a plate of earthen ware pierced by a circular row of holes, the object of which is to equalize the blast of air so that it may strike against all parts of the grate with equal force.

The ash-room is indeed frequently sunk into the ground, in order that the other parts of the furnace may not be raised too high for the purposes for which they are designed, and hence is often called an *ash-pit*, although it may really be above the level of the ground. A proper ash-pit, if small, must have a sloping floor, that the ashes may be easier drawn out; or, if large, steps are made into it to allow the operator a free passage to the door. The cavity made by this slope, or the steps, is sometimes, as by the founders, covered over with an iron grating, or by a trap door, with holes bored in it to admit the air. In this case, as the ash-room door could not be well got at, even if the furnace was provided with it, an iron plate, or loose board, may be used to cover more or less of the grating, or trap door, and thus regulate the draught, or stop it entirely.

The Ash-room Entrance.—The ash-room entrance is generally united with the entrance for air in air furnaces; but it is far better to have them separate, and to keep this entrance constantly shut by a door, and this the more especially, because it will very frequently happen that the position of the one is unfavorable for the other. Count Rumford's circular slide is usually fixed in an iron door for this entrance.

The Grate.—The grate is one of the most important parts of an air furnace. In small furnaces it is frequently of pig iron, and cast in a single piece, but in the larger grates each bar is cast separate, and has a shoulder at each end, and sometimes when they are two feet or more in length, they have also another shoulder in the middle, by which they are made to keep at a proper distance from each other. The bars are from one inch and a half to three inches deep, according to their length, and about one inch thick. They are put in so as to rest loosely upon bearing bars, placed across the top of the ash-pit, that they may be taken out easily, and renewed if it be necessary.

In the furnaces intended for boiling water, or a similar heat, a distance of half an inch between the bars is sufficient. In those for greater heats, as in distilling, with earthen retorts or iron cylinders, the distance should be about three quarters of an inch, and in melting furnaces a full inch.

When furnaces are used to heat steam-boilers, brewers' coppers, stills for ardent spirits, or evaporating pans in salt works, alum works, or the like, the grates are usually made of greater extent, in order to expose a large surface of the heated fuel, even to the extent of four or six feet square, and it is computed, that with half inch spaces between the bars, each square foot of the grate will consume about 11 pounds of Newcastle coal every hour. Now, although these large grates are laid sloping down towards the back of the furnace at an angle of twenty, or even thirty degrees, or with a fall of from five to seven inches and a quarter in each foot, yet there is a difficulty of spreading the coals equally over the surface of such large grates; and the coals also run into large masses of clinkers, which are very troublesome to extract out of the fire.

When the purposes for which a furnace is constructed are such that a small fire is required at one time, and the heat must be vehement at another, Dr. Bryan Higgins used loose iron bars, an inch square, instead of a grate. For a moderate fire, so many of these bars were placed upon the bearing bars fixed in the walls of the furnace as to leave interstices of half an inch between them. When the fire required to be increased, one or two of the bars were withdrawn, and those left on the bearers arranged at equal distances by the poker. If by chance any accident happened which required the fire to be suddenly stopped, the whole of the bars being withdrawn, the fuel descended at once into the ash-room.

The Fire-Room.—In respect to the fire-room, the principal care is to surround it with those substances which conduct heat

the slowest, in order to prevent the fuel being expended in waste. The side walls should therefore be double, with a space of about two inches and a half between them; the two walls being tied together, as the bricklayers express it, by bricks from space to space, and this may either be left empty, or filled with ground charcoal or coke.

[Wood ashes are preferable for this purpose; its non-conducting powers are nearly equal to those of charcoal, and it is not liable to be burnt out by exposure to the air through the chinks, which are constantly occurring in the walls of furnaces which are subjected to high heats.]

The inner wall must be constructed of such bricks as will bear the action of fire without running into glass; and these must be set in an argillaceous cement of a similar nature, and commonly called fire lute.

The fire-rooms of portable furnaces, which in England are usually made of iron plate, are in like manner lined next the iron with charcoal powder, made into a consistent mass with clay water, and next the fire, either with fire bricks, fire lute, or a mixture of charcoal or coke powder, with any clay that will bear the fire. Sage has recommended asbestos, ground, and mixed into a paste with the mucilage of gum tragacanth, for the composition of portable furnaces.

With a view to avoid both the inconveniences lately mentioned as incident to large grates, Mr. Losh, of Point Pleasant, Northumberland, in a patent which he took out in 1815, recommends for furnaces of the kind there mentioned, the use of two or more, even as far as six grates, with as many separate fire-rooms; and he avers, that from his long experience in the management of a large chemical manufactory, that this plan is attended with a great saving of fuel, and the boiling, generating of steam, distillation, and evaporation, goes on in a more equable manner; and also that the manual labor of the stoker is considerably less when several small fires are used to heat these great pots than when only a single immense fire is to be minded; to which there may also be added the facility of repairing the fire-places without stopping the operations.

There is another view with which two grates and as many separate fire-rooms are constructed under large boilers. These furnaces require a copious supply of fuel, which is generally raw coal, and emits of course a large quantity of black smoke every time a fresh supply of coal is put upon the fire, to the great annoyance of the neighborhood.

With a view to get rid of this inconvenience two plans have been adopted. Mr. Watt, in 1785, constructed a small second fire-room and grate between the principal fire-room and the chimney, in which he kept a small fire of cinders, coke, or other clear burning fuel, in order that the smoke as it passed over this clear fire might be burned; but this plan has not been found to answer completely, as the necessary supply of air for the combustion of the smoke could not be supplied through this small secondary grate.

Lately, Mr. Newman has proposed another somewhat similar construction. He builds two fire-rooms and grates side by side, which communicate with each other; each of these fire-rooms has a vent into the chimney, which can be opened or stopped at pleasure. Supposing, then, a fire is made in both fire-rooms, and the vent belonging to the fire-room A is open, and that of B shut, the smoke generated on adding fresh fuel to B, will have to pass over the surface of the fire in A, and thus be burnt for the most part in its passage. The next parcel of fuel is to be supplied to the fire-room A, and for this purpose the vent of the fire-room B is to be first opened, then that of A closed, and lastly the fuel supplied, the smoke from which will then be obliged to pass over the surface of the fire in B. In this alternate mode the two fires are to be supplied, and the smoke from the one made to pass over the other.

Stoking Hole.—A stoking hole is necessary in furnaces for lighting the fire, and extracting the clinkers that are formed. For the convenient performance of these purposes, this hole must be on a level with the grate, or nearly so; and if the grate is formed of loose bars, which are to be occasionally pulled out, or put in, as a greater or less degree of heat is required, it should descend a little below the grate, to give room for this purpose.

This hole is generally closed by an iron door lined with clay, or a piece of fire stone. For the purpose of ascertaining when the fire wants stirring, or replenishing, a hole about an inch in diameter, and covered by a piece of iron, which hangs loose by a rivet above, is sometimes made in this door.

Feeding Hole.—The feeding hole, by which fuel is supplied to the fire-room, is usually on the side, a little above the height to which the fuel reaches, but sometimes on the top of the fire-room. It should be made large, that a considerable quantity of fuel may be added at once, and thus the frequent opening of this hole, and the consequent cooling of the interior of the furnace, be prevented.

This opening is very often closed by means of a door hung on hinges, or sliding up and down, being supported by a counter weight; sometimes a stopper is used, but these are apt to stick; the door or stopper is usually made of iron, and lined with fire lute, or in small furnaces the stoppers are made of clay.

Sometimes what is now called a *hopper* is used, which is made of cast iron plates, and set rather sloping in the furnace. This being filled with coal, has its outer end stopped up with small caking coal, and as the fuel in the fire-room is consumed, that in the hopper is pushed in to supply its place, care being taken respecting the keeping of the outer end stopped by the small coal.

Even in this method of feeding the fire, cold air is necessarily admitted, and the interior of the furnace cooled in consequence; so that although hot air be admitted into the chamber, yet the smoke will not take fire until some time after the coals have been added.

To avoid this inconvenience, close hoppers have been contrived with a moveable bottom, formed either of a sliding plate, or one moving on a hinge and held up by a counter weight equal in effect to the weight of the coal contained at any one time in the hopper, which is closed at top by an iron lid shutting very close. This close hopper, being built in the furnace, directly over the fire-room, or at least the front part of it, is filled with coal, the lid shut down, and when the fire wants replenishing, the bottom is opened, and the coal of course falls down on the fire, without the introduction of any cold air to cool the interior of the furnace.

When this mode of feeding is adopted, it will be advisable, just before the letting fall of the fresh coal, to push that already in the furnace towards the back by means of an iron hoe, as wide as the fire-room, and about four inches deep, with a long iron handle passing through a hole in the bottom of the stoking door, and which hoe remains constantly in the furnace, being pulled up close to the stoking door, before the fresh coal is let fall.

A feeding hole, distinct from the stoking hole, is seldom used in England, notwithstanding its advantages were set forth by Mr. Dossie, in his "Elaboratory Laid Open," fifty years ago. He very justly observed, that if the fuel can only be thrown in at the stoking hole, there exists a necessity for having the area of the fire-place large, since otherwise a sufficient quantity of fuel cannot be made to lie upon it. For if the grate be small, the coals tumble out, whenever it is filled to any great height, every time the door is opened.

Now the disadvantages consequential to the having the fire-place too large are manifold; for if the space occupied by the bars be great, and the whole area they make be covered with coals, the heat will be too strong on many occasions.

If the whole area be not covered, a false draught is made through the uncovered part, which greatly weakens both the degree and effect of the fire proportionably to the quantity of fuel. As the influx of the air will be the greatest through the naked part of the area, which much weakens the draught through the coals, at the same time it greatly refrigerates both the furnace and its contents; so that not only a great waste of fuel is in such case made, but the latitude in the degree of heat, and means of accommodating it to the occasion, which are to be completely had in furnaces well constructed, are hereby greatly limited. This defect may, he observed, be remedied by making a proper feeding hole, sloping slightly towards the fire, some inches above the surface of the fuel, when at the highest.

Through this hole the fire may be fed by a shovel of a fit size and figure, or

stirred with a poker, properly bent, without using the door for those purposes, which need, therefore, only be opened for the making or lighting the fire, or freeing the bars from the scoria or clinkers, when they are choked up with them.

This manner of feeding the fire will be found a very great convenience to those who are accustomed to it. As the effectual draught of the furnace may be thence greatly increased, the lighting the fire much facilitated, and the operator likewise enabled to have what body of fuel he pleases in the furnace, and to adequate the heat with certainty to any occasion, without either being subject to have the fire extinguished when it is kept low, or not to admit of being raised high, with the falling out of the coals, already in the furnace, every time he attempts to throw in a fresh supply.

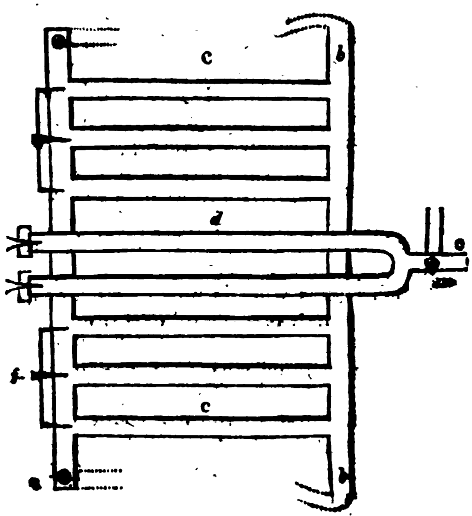
When this device is used, the usual area of the bars may be diminished at least one half; and the consumption of fuel will be lessened much more than in that proportion, for the reasons before given. The operation will not be soon checked, on any neglect in keeping up the fire, which is liable to happen when furnaces are built in the common way.

The Throat.—In many furnaces there is no visible throat between the fire-room and chamber; the walls of the two rooms being continued in a line. In some, however, the separation is very distinct, and the throat is either a simple opening, the lower limit of which when on the side is usually called the bridge, or instead thereof, a number of small holes disposed generally in a quincuncial order, or chequerways, by which arrangement the distribution of the heat through the chamber is rendered more equal than when only a single opening is used. In this case care must be taken that the sum of the area of these holes shall not exceed that of the free space between the bars of the grate, otherwise the desired equal distribution of the heat cannot be obtained.

[From the London Mechanics' Magazine.]

Improvement in the Fire Bars of Locomotive Engines.

Sir,—The Rev. Dr. Lardner, in his evidence given before the Select Committee, says, "that he has witnessed a new set of grate bars melted in a single trip between Manchester and Liverpool." From this I conclude that the fire bars of locomotive engines are generally red hot; and supposing this conclusion to be correct, it strikes me that the red hot bars may be rendered of use to the engine,—first, by increasing the energy of the fire, should the steam flag on the ascent of long hills, or in going over heavy roads; and, second, by producing a brilliant light, when locomotives undertake night journeys. Both these objects I propose to effect, by using hollow fire bars, and making them serve as so many small oil-gas retorts; or at other times permitting the air to pass through them to the furnace.



Suppose the front bar *a*, and back bar of the grate *b*, hollow, and of larger dimensions than the hollow fire bars *c c c*, all which open into them, except the two centre bars *d d*, which pass through both. In the front bar *a*, just opposite each fire bar, are entered jet points *f*, connected with a small forcing pump, with which the attendant may alternately inject oil into the bars on the right and left of the centre; which oil being converted into gas will pass into the bar *b*, from each end of which a pipe should pass upwards to the side or front of the furnace, as the form of the boiler may render most advisable. Previously to injecting the oil, the valves *e*, in the bar *a*, should be screwed down to prevent the air from entering. A pipe from each end of *a* should be carried down, and then to the forepart of the carriage, and end in a funnel.

To supply the gas for lighting the carriage, let the two centre bars, after passing through the back bar *b*, be united. There may be placed at *m* a three-way cock, to al-

low the passage of the air through the pipes by day, when the jet caps are unscrewed; and a communication may be opened by the pipe *o*, (which should pass through the cold water supply tank,) with the gas holder, during the night, the oil to be injected into the bars, *d d*, alternately by the engine.

I remain, sir, yours respectfully,

J. R. WHITE.

Wells, Somerset, Feb. 24, 1835.

P. S.—Has not Colonel Macerone given us a pretty good hint of the manner in which Dr. Church effects his condensation? There must certainly be some strong resemblance between Mr. Hall's mode and Dr. Church's. Since speaking of one leads to mentioning the other, why not place Hall's fascine of condensing tube horizontally, and supply the place of water with an air draught or blast to the furnace, thus warming the air and condensing the steam? J. R. W.

[From the Journal of the Franklin Institute.]

Report to the Board of Directors of Bridges, Public Roads, and Mines, upon the Use of Heated Air in the Iron Works of Scotland and England. By M. DUFRENOY, *Engineer of Mines. Paris*, 1834.

(Continued from vol. v., page 328.)

ENVIRONS OF DERBY.

The coal basin of Derby, a prolongation of that of Sheffield, contains many large iron works; three of them, the Butterly, Codnor Park, and Alpdon works, have adopted the hot air blast. I visited the first two, under the charge of Mr. Jessop, one of the most intelligent iron masters in the kingdom. The heating apparatus of all these differ from those I have described, and, in some essential respects, from each other. For this reason, I have deemed it proper to describe them in detail, though the results which they give are not so favorable as those obtained at the Calder works.

Butterly Iron Works contains three smelting furnaces. The iron there made is intended for castings, either of first or second runnings. One furnace only was in blast when I visited Derbyshire. The air for the blast was heated by an apparatus at each tuyere; this apparatus was composed of the large pipes, A B C, (figs. 11 and 12,) 27 inches diameter in the clear, placed horizontally one over the other, and separated by arched plates, *m n*, *m' n'*. These pipes are connected in pairs, by elbow pipes, *d e*, *d' e'*. The air from the blast engine enters by the pipe *c*, and makes its exit at *g*, after having passed the length of the three pipes successively. The joints are placed on the outside of the furnace proper; but to prevent the air being cooled in traversing the elbows, they are cased in brick-work.

The elbows connecting the long pipes are in plates, connected by bolts and nuts, passing through lugs, or flanges. The pipes are one and a half inches thick, and rest upon fire lumps, *t t*, placed at proper distances upon the arch plates, *m n*, *m' n'*. This disposition allows the flame to envelope them on all sides.

The first pipe, A, is not exposed directly to the action of the fire; it is separated from the grate by an arch of brick, extending the whole length of the furnace, which allows the flame to pass by the flues, *v v*. The partitions, *m* and *n*, have openings, *p* and *q*, placed at the opposite ends of the furnace, so as to compel the flame to traverse the whole length, without escaping from one story to another. All the arches are of fire brick, one brick thick. The expenditure of this apparatus is 62 cwt. for each ton of casting made. The air is raised to 360° Fahr. Notwithstanding the feeble temperature, a great economy of fuel is effected, as indicated below.

Consumption and products during the first week in July, 1830, from furnace No. 2, worked with cold air, 159 tons 5 cwt. of coke,—corresponding to 218 tons 10 cwt. of coal, 109 tons 17 cwt. of ore, and 35 tons of flux,—produced 83 tons metal.

Consumption and products of furnace No. 2, on the 17th of July, 1833, heated air being used: The furnace received forty-one charges, each composed of 9 cwt. crude coal, 9 cwt. ore roasted, and 3 cwt. flux. The average of the first fortnight in July had been forty charges per day, and the iron produced seven tons.

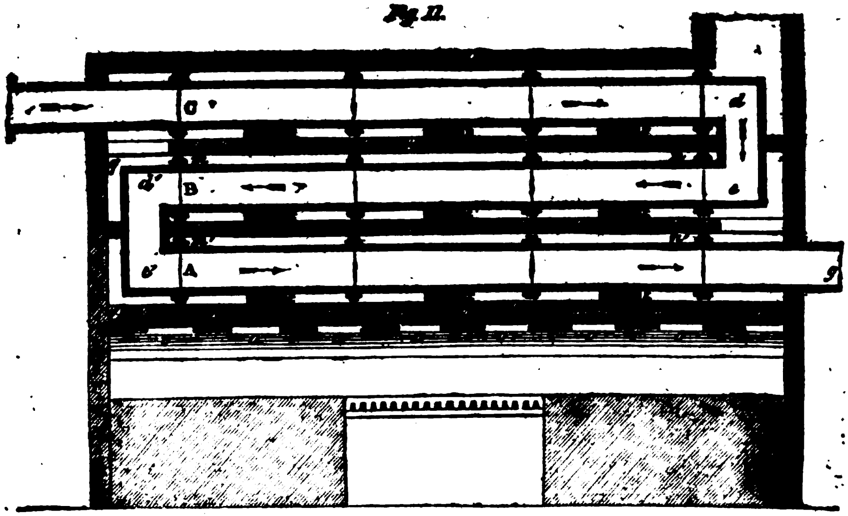
Upon comparing, from these data, the consumption of the two periods, one ton of iron required as follows:

1830. Cold air and coke—Coal, 5 tons 16 cwt.; ore, 3 tons; flux, 1 ton.

1833. Heated air and coal—Coal, 2 tons 18 cwt., including fuel to heat the air; ore, 2 tons 11 cwt.; flux, 1 ton.

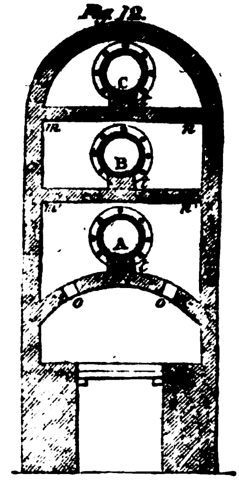
To know the whole expense of fuel, that used by the blast engine must be added, for which I have no precise data;

Fig. 11.



but this expense must necessarily diminish in proportion to the increased yield of the furnace.

Fig. 12.



At Butterly, therefore, a saving of one half the fuel has been effected by the introduction of the new plan. The quantity of flux remains the same, because the sulphurous nature of the coal requires a large proportion of lime.

The blast engine, which served but two furnaces, now works three; but to obtain this increase, a larger cylinder was put in. Formerly, the cylinder was seventy inches in diameter, and eight feet stroke, working thirteen revolutions; now, the cylinder is eighty inches, the length of stroke and number of revolutions remaining the same.

The quantity of air expended, which was 2,500 cubic feet per minute, is now reduced to 2,160 feet; but the pressure, two and a half pounds to the inch, has undergone no variation. The opening at the mouth of the tuyere has been reduced from two and a half to three inches; the iron produced is intended for castings.

Codnor Park Works.—This work consists of three furnaces, three refineries, and a sufficient number of puddling furnaces to work up all the metal. These furnaces have worked for the past year with heated air and crude coal. The substitution of heated air has produced a saving of fuel similar to that stated for Butterly; 2 tons 9 cwt. being now sufficient to obtain one ton of metal, which formerly required five tons. It should be remarked, that the expense of coal has always been less at Codnor Park than at Butterly, on account of the difference in the quality of iron produced. This difference would be much more sensible, if the same quality of coal was used at both works; but at Codnor Park the soft coal is used, while at the other a variety called cherry coal is used, which better resists the action of the blast.

Consumption for one ton, using cold blast: Butterly, 5 tons 16 cwt.; Codnor Park, 5 tons.

Same with hot air—Butterly, for smelt-

Fig. 13.

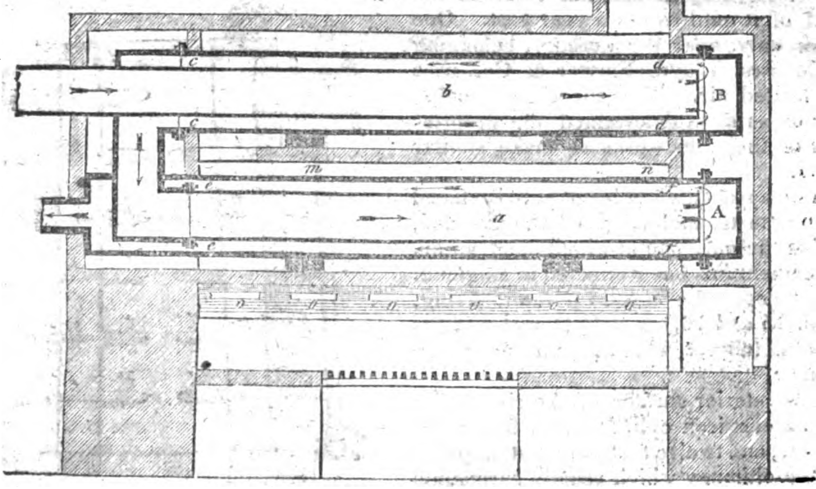
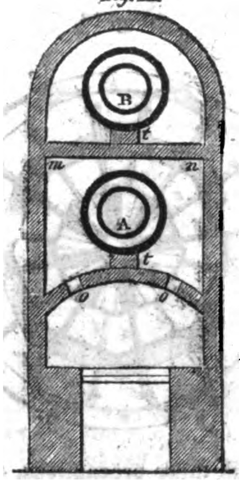


Fig. 14.



ing 2 tons 12 cwt., apparatus 6 cwt., total 2 tons 18 cwt.; Codnor Park, for smelting 2 tons 9 cwt., apparatus 6 cwt., total 2 tons 15 cwt.

The apparatus employed at Codnor Park, for heating the blast, is composed of two pipes, A and B (figs. 13 and 14,) placed one above the other, in which are inserted small pipes, *a b*, having the same centres as the large pipes, A and B. These pipes are connected by elbows, so that the air, in passing from the blast engine, through the interior pipe, *b*, spreads itself over the circular space, *c d*, between the pipes B and *b*; passing then into the second interior pipe, *a* is transmitted to the furnace by traversing the second circular space, A.

This disposition of double pipes, one within the other, was adopted to remedy a serious inconvenience experienced at Butterly,—an inconvenience incident to pipes of large diameter, in which the air being heated unequally, a current of cool air passes along the centre of the pipe, and renders it impossible to raise the temperature sufficiently.

The pipes, A B, are of cast-iron, thirty inches diameter outside, and one and a half inches thick; the small pipes, *a* and *b*, are of boiler iron, six-tenths of an inch thick, and eighteen inches diameter in the clear. The construction of the furnace is the same as at Butterly—figs. 13 and 14 giving an exact idea of it. The air is heated, by means of this apparatus, to 400° Fahr., with a consumption of 6 cwt. coal.

We have already stated that all the metal made at Codnor Park is made into malleable iron;* this iron is used in the machine shops of Mr. Jessop. It serves equally well for boiler iron for steam engines, which requires the very best metal.

ENVIRONS OF BIRMINGHAM.

The introduction of the hot air blast has scarcely commenced in the Staffordshire iron district, the opinion being still prevalent that the quality of the iron is

*This is an error, as large quantities of pipes are cast at this work for the London market.—[Editor.]

deteriorated by its use, has retarded the trial of it until within a year past. One work only, near Wednesbury, belonging to Messrs. Lloyd, Forster & Co., uses the heated air. The success attending this experiment determined the proprietors of the other works to make similar trials.

The apparatus employed here is placed above the trunnel head of the furnace, and is the only one at which such an arrangement has been effected in England. It is composed of a solid pyramidal ring, (figs. 15 and 16,) A B C D, and a series of small tubes, *t*, which penetrate into the furnace.

The interior surface of the ring, *a b c d*, is a cast iron cylinder, four feet in diameter, and twelve feet in height, in place of the chimney which usually surmounts the trunnel head of the furnace. The exterior surface of the pyramid is octagonal, and made of boiler plates, riveted together like a steam boiler, its diameter at the middle being six feet; a space is left between the surfaces of one foot on all sides; to protect the outer surface from the cooling action of the air, it is encased in brick-work.

The air, passing from the blast engine, is carried to the top of the furnace, circulates through the pipe, *e e e*, on a level with the top of the furnace, then divides itself among the eight vertical pipes, *f g*, placed round the outer surface of the casing, which are connected with the circular pipe; each of these vertical tubes communicates with the interior of the case, or pyramid, by six small tubes, which pass into projections within the interior of the furnace.

This part of the tubes, *t*, enters into the pipes, *t'*, closed at the extremity; so that the air, in moving, is forced to spread itself over the surface of the heater. These tubes, *t'*, are all of cast iron, and are connected with the distributing pipes, *f g*, by leather sleeves, *t''*.

The air, after being heated in the tubes, *t'*, and in the circular heater, A B C D, *a b c d*, re-ascends to the tuyeres by the opening, *v*. To prevent the air from cooling during the transit, the conductor is placed in the chimney of the steam boiler, twelve or fifteen feet distant; a kind of brick-work connects the furnace with this chimney.

Fig. 15.

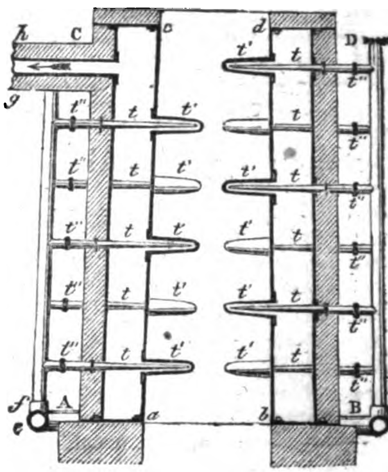
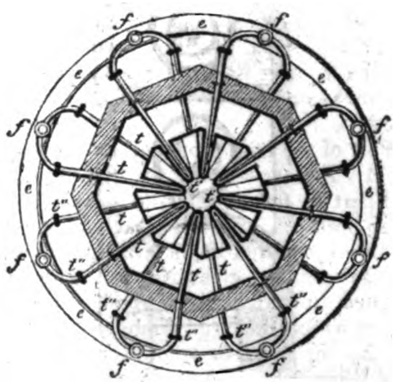


Fig. 16.



With all these precautions, the temperature of the blast cannot be raised higher than to 360° Fahr., and they are obliged to heat it again in a furnace, within a few feet of the embrasure of the furnace.

The consumption of this fire is nearly 4 cwt. of coal to the ton of iron.

This apparatus is very costly, and requires frequent repairs; the little saving of fuel effected by it, (about 3 cwt. of coal per ton of iron,) is more than compensated for by the expense of construction and repairs, and, above all, by the numerous interruptions which take place in consequence of repairs required almost daily.

The introduction of hot air has effect-

ed, in these works, the same economy as in the others cited, where this plan is adopted. One ton of iron required, in 1831, 3 tons of coke, equal to 5 tons 9 cwt. of coal; now, the same quantity of iron consumes 2 tons 14 cwt. of coal, as the following statement shows:

On the 20th July, there passed through the furnace twenty charges, composed of 10 cwt. crude coal, 9 cwt. roasted ore, and 6 cwt. flux. The product being 8 tons of metal, each ton consumed 2 tons 10 cwt. coal for fusion, and 4 cwt. coal for heating the apparatus—total, 2 tons 14 cwt.; ore roasted, 2 tons 5 cwt.; flux, 1 ton 10 cwt.

The consumption in flux was considerable, because of the sulphurous nature of the ore. The slag which came from the furnace was crystalline, and gave off very strong sulphurous odors. Before the introduction of hot air, the daily production of the furnace was only six tons. They have, therefore, obtained, besides an economy in fuel, a diminution of the general expenses, and of labor. The quantity of blast has not been changed, but the tuyeres have been enlarged from two inches nine lines, to three inches six lines.

Part of the iron produced at the works of Mr. Forster is used for the foundry, and part for fine metal; the same running gives both kinds of iron; that which flows first from the hearth, is No. 1 pig metal; the last running gives No. 2. They distinguish the two kinds of iron by the manner in which they run from the furnace, and by the furrows produced on the surface when it cools.

WALES.

There are in Wales but two works using the heated air—that of *Warteg*, and *Blaen-Avon*, ten miles from *Abergaveny*. None of the *Merthyr-tidvyl* works have introduced it, though the *Dowlais* and *Penn-y-danau* have made experiments thereon.

The abandonment of heated air in so extensive an iron country, and in which improvements are sought after with care, has led many to doubt the reality of the advantages claimed for it. Some have thought that, while so much saving was effected by the use of this plan in the furnaces of Scotland, where the metal was destined for the foundry, it could not be employed by other works, the product of which is converted into bar, or malleable, iron.

The examples furnished by the *Newcastle*, *Codnor Park*, and *Wednesbury* works, in which they make bar iron of very good quality, prove that this opinion is not well founded. The partial abandonment of the plan in Wales should, in part, be attributed to the bad construction of their heating apparatus, but more especially to the diminished saving which would result to them, since the employment of crude coal has been effected; a saving which the cost of the patent would almost balance. To appreciate these reasons, it is necessary to enter into some details upon the expense of making iron in that country.

From all the information gained upon the experiments made at Dowlais, or Penn-y-danau, it appears that, the apparatus being of bad construction, the temperature of the air could not be raised to more than 300° Fahr. Notwithstanding this, they attempted, with success, the substitution of crude coal for coke. An accident happening to the apparatus, obliged them to suspend the use of hot air for several days, and showed them that, without difficulty, the crude coal could be worked even with cold air. The saving which resulted from this substitution was such, that the proprietors did not deem it worth while to repair the heating apparatus, and thenceforth abandoned it. Since that period, most of the Welsh furnaces use the crude coal, but some employ a mixture of coal and coke.

The following table shows the quantity of fuel and material required to produce one ton of metal.

	Penn-y-danau.			Dowlais.			Cyfartha.			Plymouth.		
	t.	*c.*	*q.*	*t.*	*c.*	*q.*	*t.*	*c.*	*q.*	*t.*	*c.*	*q.*
Coal, . . .	2	9	0	2	14	0	2	13	2	2	13	0
Ore roasted,	2	4	0	2	9	0	2	6	2	1	16	0
Ashes, . . .		2	2		—			—			—	
Flux, . . .		19	2		13	0		16	0		—	

Add to this, the quantity consumed by the blast engines, about the same for each, varying from 5 to 6 cwt.

The average quantity of coal consumed in each of these works is, therefore, two and a half tons for each ton of iron. By the employment of heated air, it is not probable that a saving would be effected over this expense of more than 33⅓ per cent., or 17 cwt. of coal for each ton of

iron; deduct from this, the fuel consumed to heat the apparatus, estimated at 6 cwt., and the actual saving would be reduced to 11 cwt., costing, at 3*s.* 7*d.*, or 86 cents per ton, at the works, 44 cents; and as the patent right is charged at one half, or 24 cents per ton of iron, the saving would be diminished to 20 cents per ton. This economy, itself very small, would scarcely be appreciated in a district where all the materials are so cheap, that iron may be produced at a less price than in any other district in Great Britain.

I believe, therefore, that the non-adoption of this plan in Wales, is no evidence that it does not effect any saving in fuel; but, on the contrary, it leads me to think that there would be economy, as in other works where the plan is used; but it is evident that, the expense* of coal being very small in Wales, the economy would not be as marked as in the works of Scotland.

The *Warteg Iron Works*, which have been named at the beginning of this section, sustain this opinion. In this establishment, the heating apparatus is composed of a very short developement of pipes, so that the air cannot acquire a temperature of more than 400° Fahr. The coal, which is very bituminous, and loses 55° per 100 in the coking, cannot be employed crude in the furnace, with the air at so low a temperature; it results from these circumstances, that the saving obtained is not so great as at the furnaces of Scotland, but is to be compared to the saving in those works where the apparatus is not so perfect, and where coke is still used. Nevertheless, the diminution in the cost is very marked: before the introduction of heated air, one ton of iron required a consumption of two tons of coke; the produce of four tons, three cwt. of coal. The consumption of coke is still about the same, but, as there is no necessity for carbonizing it so completely, it is now produced by only three tons of coal.

The yield of the furnace has been augmented from six to eight tons of iron, each, in twenty-four hours.

* The author should have attributed this difference, in a great degree, to the superior quality of the Taff Vale coal over the Scotch, the former yielding more than 75 per cent. of carbon, while the proportion in the latter is less than 65 per cent.; some varieties even as little as 51 per cent.—[Trans.]

[From the Richmond Compiler.]

New Moving Power.—The article below from Mr. James Herron, civil engineer, upon the subject of *a new propelling power* upon railroads, is one which deserves, and will unquestionably receive, the calm and dispassionate consideration, not only of scientific men, but of all who feel an interest in the advancement of science. The friends of Internal Improvement should give it their most patient attention. Its novelty may startle them, but what great suggestion in any age did not at first excite doubt of its feasibility? Witness the fate of Fulton and Oliver Evans. They were deemed insane and visionary in their day, but they are now ranked amongst the wisest men of our country, and the sigh of regret often escapes at the ingratitude and dullness of their countrymen.

Mr. Herron may expect to combat with incredulity, ignorance, and personal rivalry; but still he will find intelligent men disposed to consider with an impartial disposition the merits of his scheme. We pretend to but little science, but we confess we are struck with the feasibility of his plan. We think it deserves examination, and we are glad to find that an engineer, high in the estimation of the public, not only gives Mr. Herron's views a fair and liberal consideration, but seems disposed to concur in the principles upon which they are based.

In this era of improvement, every man who can make even the slightest addition to the cause of science, should be encouraged to the fullest exertion of his faculties for the public weal.

Hydrodynamic Railway, or the Application of the Power of Rivers to the Rapid and Cheap Transportation of Produce and Merchandise.

It has long been with me a matter of doubt, whether the water used in the lockage of canals was not in many cases an injudicious application of a valuable power, as in the case of a canal located along the valley of a great river having considerable fall in its bed, like that of the river James, which has 1222 feet fall from Covington to tide water, or about 4.74 feet per mile, rendering at least one lock necessary for every two miles in the average.

On investigating the subject, I find that I will therefore lay before you, in as succinct a manner as possible, this new though simple deduction of science.

The locks of the Chesapeake and Ohio the water power of the river is of itself equal to the transportation of a greater quantity of tonnage than can be passed through the largest canal, and this too with the astonishing rapidity peculiar to railroads.

Canal are 100 feet long, 15 wide, and, say we take one of the most approved lift, 8 feet, the "prism of lift" will then contain 12,000 cubic feet of water, which will weigh 750,000 pounds. Every time the lock is emptied, this quantity is transferred from a superior to an inferior level. If the valves are opened simultaneously, I am informed that the lock can be filled and emptied in little more than two minutes; but say that it takes three. Now, this water is power, and if it were applied to a properly constructed "breast wheel," or where the fall of water is greater, to a "pitchback," we should have four-fifths of it available to set any machinery we think proper in motion. Let it be applied to an endless chain or rope, passing over suitable rollers along the line of a railway, after the manner of the stationary system of steam engines, we shall have a water power railway, entirely free from the objections that can fairly be urged to the stationary steam engines, of the necessity of keeping up the fire and steam, &c.

When the stations are two and a half miles apart, one twentieth of the power, according to Tredgold, will be expended in moving the chains; but I will allow a tenth of the power to effect this object on two mile stations, the chain being worked but for one mile.

We have then the four-fifths of 750,000 pounds, (the one-fifth being lost in the application to the water wheels,) equal 600,000 pounds, which, falling 8 feet in three minutes, is equal to 1818 pounds moved half a mile in the same time; which is at the rate of 10 miles an hour. Deducting from this the one-tenth, as that part lost in moving the chain, leaves 1637 pounds. And as 10 pounds are equal to the transportation of a ton, with the commonest railway wagons, it follows that the above power is equal to the transportation of 163.7 tons over half a mile of the road, while a boat would be passing through the lock of the canal; or it will transport 81.8 tons over a mile of the road in the same time, which is at the rate of twenty miles an hour!

But the maximum rate of transportation on canals is 2½ miles an hour, and as the mass moved is inversely to the velocity, we shall at this rate be able to transport 654 tons.

The water used would be at the rate of 66.6 feet per second. James river, even at Covington, in a dry season, yielded nearly three times this quantity, as appears from the Report* of Mr. Crozet, who measured Jackson's river and Dunlop's creek in August and September, 1826. The mean of the results obtained by this engineer is 177.6 cubic feet per second, or 10,656 feet per minute; and we have this quantity with 7.11 feet fall per mile, the average down to Pattonsburg; before reaching which, however, the volume of water is more than doubled; and as we descend the river, although we have less fall per mile, we have at least six times the quantity of water to compensate for it; and the fall is still about 3½ feet per mile.

The heavier trade being descending, will add to the effect of this power; but disregarding this favorable circumstance, omitting the decimals in the fall per mile, and taking the minimum quantity, we have 10,656 cubic feet of water, equal in weight to 666,000 pounds, which, if permitted, will of course fall the 7 feet in a minute, and is therefore equal to 4,662,000 pounds falling one foot. Deducting one-fifth for loss in application, leaves 3,729,600 pounds. Now the load we can transport will depend on the velocity at which we would travel—say that it shall be 10 miles an hour, which is 880 feet per minute.

Dividing 3,729.600 by 880, the quotient is 4,238 pounds, moving with the velocity of 10 miles an hour!

From 4,238 deduct the one-tenth part, for that lost on mile stations, in moving the chain, or rope; and dividing the remainder by 10 for the friction per ton of the carriages, and we have 381.5 tons transported at the rapid rate of 10 miles an hour!

And as each and every mile furnishes its own moving power, it follows that it is equivalent to keeping this quantity in motion on each mile throughout the line at the same time. And as the distance from Richmond to Covington is 257½ miles, this may amount to the enormous quantity of 98,236 tons; or to the transit and delivery of 3,815 tons hourly!

Having thus demonstrated the amplitude of this moving power, to an extent probably far beyond any demand we shall be able to make on it—which will be better understood by the general reader from the fact, that but 17 hours would be equal to the transportation of a greater quantity of tonnage than passed over the whole Baltimore and Ohio Railroad in a year, ending 30th September, 1833—it now remains to show that it can be employed at a reasonable expense.

The expense of erecting works for hydrodynamic transportation will depend on their scale, or magnitude, and on the greater or less permanent character of the materials used in their construction; also, on the extent to which we would employ the motive power. With regard to the latter, however, it should be observed, that we obtain

* 1 Vol. Board of Public Works, page 108.

it so cheaply, and in such excess, as to obviate, to a great extent, the necessity of expensive grading. This adaptation of fixed power to an undulating surface, of any degree of slope, renders it peculiarly applicable to mountain localities, as by its means we can cross the bends of the river, thus shortening the distance, while a canal, or even an ordinary railroad for locomotives, should be conducted round them.

Another important advantage derived from the employment of this cheap power, is that we can substitute, for the iron rail, a broad granite tramway, similar to that extending from London to the West India Docks; which, although it will cost more per mile in the first instance, yet it will have great permanency to compensate for this. But the most important advantage to be derived from the granite tramway, is, that any man may bring his own farm-wagon, and, leaving his horses behind him, be drawn to market at a rate of 10 or 20 miles an hour, which would be in less time than would be spent in passing the locks of a canal: thus freeing the work entirely from the odious charge of monopoly brought against railroads.

To form an estimate of the cost, it will be necessary to suppose the works adapted to some definite amount of trade. Say that it shall be to the delivery of 100 tons per hour, or to the transportation of 50 tons at a time, at the rate of 10 miles an hour.

For this purpose I will suppose it necessary to erect a dam at every four miles; and that they may be built in the most substantial manner of stone masonry, I will estimate them at $10,000 each; the average width of the river up to the Blue Ridge is 699 feet; above the Ridge, it will only be 275 feet. For water wheels of the best and most durable construction, say $3000.

Thus we have 13,000, which, divided by 4 miles, gives $3250 per mile, as the cost of the moving power.

Estimate of the expense.

Motive power, or proportional cost of dams per mile, - - - -	$3,250
Ropes, a double line per mile, -	1,800
Rope rollers, put up, - - - -	850
*A broad granite, or marble tramway, double track, - - -	8,000
Grading and bridging per mile, say	2,000
	$15,900
Add 10 per ct. for superintendence,	1,590
	$17,490

* Wood and iron rail tracks, like those on the Petersburg Railroad, could be laid in a double track for 6000 dollars a mile. They would last much longer than when locomotives are used.

High and unfavorable as the above estimate is, yet the whole cost of the moving power, including dams, water wheels, ropes, and rollers, will be much less per mile than such locks as those of the Chesapeake and Ohio Canal, which cost, as I am credibly informed, $1500 the foot lift.

I have estimated for ropes, as they are in more general use than chains; and the above will be the cost of the newly invented rope, saturated with India rubber, expressly for this purpose; which is said to increase its strength as well as its durability.

When the stations or water wheels are placed 4 miles apart, each wheel would have to work 2 miles of the road at a time; but did the trade require it, double, or probably treble the foregoing tonnage, could be delivered by erecting an additional water wheel at each station.

The following is the estimate of the amount of power to work the 4 mile stations, which those conversant with the subject will perceive to be very ample.

Friction and resistance of two miles of rope, - - - -	600 lbs.
Ordinary friction of 50 tons of carriages and goods, 10 lbs. -	500 do.
Allowance for occasional gravity, at 20 lbs. per ton, - -	1000 do.
Power allowed at the rate of ten miles an hour, - - -	2100 do.

2100 pounds moved 880 feet in a minute, is equal to 1,848,000 pounds moved 1 foot; which is equal to 154,000 pounds falling 12 feet in the same time, which is, also, equal in weight to 2464 cubic feet of water. To which add one-fourth, for loss in application, and we have 3080 feet per minute, or rather more than 51 feet per second.

For the sake of conveying an idea of the probable cost on a large scale, I have supposed isolated dams to be used at regular distances, but the engineer will of course adapt his works to suit particular localities, sometimes preferring a continuous canal, substituting water-wheels in place of locks, and thus discharging the water, as it is used, into the next consecutive reach below. Or where great length of level occurs, the wheels may be made to discharge their water into the river, to be again taken out of the next dam.

On canals already constructed, where they have considerable lockage, and plenty of water, it is obvious that the trackage may be effected by the foregoing means; that is, by erecting a water-wheel along side of a lock, and extending a chain down the margin of the canal on the one side, which would be returned up the other.

And as they no longer need the tow-path,

they may lay a light rail track, on which passenger cars may be drawn by the same power at any required velocity.

But in many cases, where they have not a superfluity of water, they had better substitute water wheels for their lock gates, widen their tow-path, and lay down a railway.

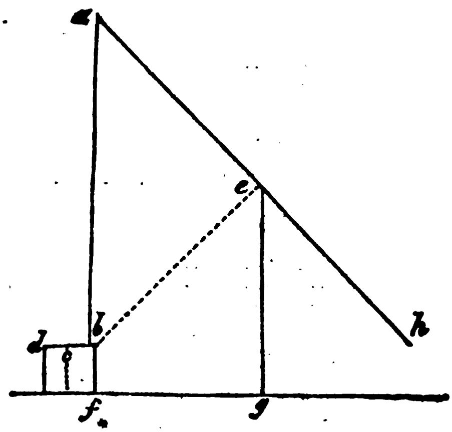
In conclusion, I invite investigation by men of science, as it is certainly a subject of great importance to the country, now so extensively engaged in works of internal improvement.

JAS. HERRON,
Civil Engineer.

Richmond, Va., May 26, 1835.

[For the Mechanics' Magazine.]

To find the Length of the Sweep and Crutch for a Well—the Depth of the Well given.



Rule—The square root of half the square of the depth of the well, with the height of the curb added, is equal to the distance from back side of curb to centre of pin on which the sweep hangs; and the square root of half the space of that distance, with half the width of the curb added, is equal to the distance the crutch should be from the well, and the height of curb added gives the height of the crutch from the ground, consequently the length of the sweep will be twice the distance from the curb to centre of pin, less one foot. But to make it work easy, there should be an allowance of about six inches in height, and in the distance from the well, that is, the pin 6 inches lower, and 6 inches further from the well, which will give about one foot more on upper end of sweep, which allowance is in consequence of the upper end of the sweep being smaller.

Thus—$\sqrt{a\ b^2 \div 2} = b\ e$

$\sqrt{b\ e^2 \div 2} + c\ b = g\ f$

$\sqrt{b\ e^2 \div 2} + f\ b = g\ e$

Then, $2b\ e = a\ h$.

Examples—I have a well 21 feet deep, and the curb around it 3 feet high, and 3 feet square—required to know the length of the sweep, height of crutch above the ground, and how far I must set the crutch from centre of the well.

$21 + 3 = \sqrt{24^2 \div 2} = 17$ feet, distance $b\ e$ from curb to pin.

$\sqrt{17^2 \div 2} + 1.5 =$ 13.528 feet, distance from well.

$\sqrt{17^2 \div 2} + 3 =$15.028 feet, height of the crutch.

And $17 \times 2 - 1 = 33$ feet, length of sweep.

Then, as was stated above, we will make an allowance of six inches, or 0.5 of a foot,

$13.528 + .5 = 14.028$ feet.

$15.028 - .5 = 14.528$ feet.

S. A.

A Friend to Canals and Railroads will find in the Railroad Journal, if he uses it, the most extensive, and probably the most careful, investigation of the subject of canal navigation, that has been published. He will find, however, that according to these experiments, broad canals are not considered by Mr. Macneill as best adapted for speed.

To the Editor of the Mechanics' Magazine:

In the valuable letter of Gerald Ralston, in your last number, he speaks of General Mercer truly as the "advocate of broad and deep canals for transportation." He also advocates, and has long endeavored to draw the attention of those interested in canals, to the use of the Paisley passage boats. The principle on which their success has depended has not yet been demonstrated. But those on which he has advocated the superiority of wide and deep canals for transportation have been long known, and their truth admitted. An exemplification is given in the difference of strain on the horses on the Schuylkill canal; on the narrow canals it is hard, on the pools, easy.

You could not better serve the cause of internal communication, than by accepting the offer of Mr. Ralston, and request him to give all the information which his time and opportunities will permit on the subject of these swift canal boats.

A FRIEND OF CANALS AND RAILROADS.

METEOROLOGICAL RECORD, for the months of January, February, March, and April, 1835—kept at Avoyle Ferry, Red River, Lou. (Lat. 31° 10" N., Long. 91° 59" W.) by P. G. VOORHIES.

JANUARY.

Days.	Morn.	Noon.	Night.	Wind.	Weather.	Remarks.
1	42	64	62	calm	clear	all day
2	54	72	68	SW	cloudy	..
3	50	48	46	calm	..	..
4	32	48	42	N	clear	..
5	29	54	45	calm	..	heavy white frost
6	29	46	44	..	..	.. ..
7	31	50	50	..	cloudy	rain all day and night
8	36	48	45	NE	..	all day
9	38	46	43	calm	..	..
10	37	55	56	SE	..	..
11	46	53	58	calm	..	rain all day
12	61	64	61	SE	..	rain & h'vy thunder in e.
13	48	62	68	W	clear	all day—Red river rising—wind high
14	52	64	69	SW	cloudy	rain all day
15	46	58	52	W	clear	all day
16	32	54	56	calm	..	..
17	44	66	62	SW	..	..
18	40	68	56	calm	..	..
19	33	63	54	E	..	heavy white frost
20	60	66	64	SE	cloudy	rain all day
21	54	65	58	N	..	evening clear
22	38	67	60	S	clear	white frost
23	49	65	62	calm	cloudy	rain
24	58	70	65	S	..	rain, and heavy thunder
25	62	72	67	calm	clear	all day
26	70	86	70	..	..	..
27	60	71	64	..	..	..
28	46	71	68	W	..	..
29	70	68	56	SW.high	cloudy	from 2 to 9 a. m., most vivid lightning & h'vy thunder, light showers
30	34	41	40	W.high	clear	morn'g—day cloudy—wind high all day, WNW
31	30	42	46	calm	..	all day.

FEBRUARY.

Days.	Morn.	Noon.	Night.	Wind.	Weather.	Remarks.
1	40	56	52	calm	clear	all day—Red river rising
2	49	66	65	..	..	foggy morning—clear day—rain all night
3	40	40	40	NW.high	.	all day—most extraordinary, all day equal!
4	24	40	39	calm	..	all day—rain at night
5	28	15	46	..	..	a white frost—cloudy evening—rain at night
6	47	46	44	..	cloudy	and rain—clear evening—wind N, high
7	24	29	26	N to NW	clear	all day—wind high
8	12	26	27	calm	..	all day—coldest ever known in this country
9	20	40	46	..	..	all day
10	29	44	42	..	..	.. —white frost
11	28	54	48	..	..	.. ..
12	32	58	50	..	..	.. ..
13	38	66	64	SW.high	..	.. .. light
14	49	68	68	S to W	cloudy	rain at night
15	34	40	42	W to NW	..	some spits of snow
16	31	44	42	calm	clear	white frost
17	29	54	52	..	..	..
18	34	64	60	..	..	..
19	45	70	64	..	..	
20	49	65	66	SW	cloudy	
21	58	74	70	S.high	..	rain & h'vy thunder all n.
22	60	60	56	calm	..	.. .. all day
23	50	55	52	..	..	evening clear
24	46	59	58	..	..	morning—clear day
25	58	69	66	..	..	all day
26	50	37	36	N.high	..	rain, hail, and sleet
27	23	32	33	calm	clear	ground covered with ice
28	25	45	41	..	..	ice remains in the shade

MARCH.

Days.	Morn.	Noon.	Night.	Wind.	Weather.	Remarks.
1	30	50	48	calm	cloudy	white frost
2	40	50	52	..	..	light drift'g showers all d.
3	51	67	63	S	..	light drifting showers—rained at night
4	42	38	39	NE.high	..	light drifting showers, and rain at night
5	34	39	42	N	..	rain, snow, and sleet
6	34	48	43	calm	clear	white frost
7	40	44	44	..	cloudy	rain all day
8	43	52	50	..	..	all day
9	46	54	52	..	..	evn'g wind N to NW, clear
10	44	58	50	..	clear	white frost
11	36	61	61	..	..	great flight of wild geese this morn'g to N
12	40	66	60	slight	.	all day
13	51	70	68	S	cloudy	..
14	62	76	73	S.high	..	..
15	68	73	71	calm	..	..
16	60	77	70	..	clear	night cloudy—sowed oats and red clover—began planting corn
17	58	58	51	NE	cloudy	rain at night
18	50	67	65	SE	..	rain in morn'g, ev'g clear
19	47	65	64	calm	clear	
20	50	71	67	SE	..	
21	68	78	65	S.high	cloudy	rain at night—a heavy gale from west all night
22	45	61	60	W.high	clear	wind high fm W. all day
23	38	59	58	calm	..	white frost
24	42	65	60	S.light	..	
25	58	69	64	S	cloudy	
26	62	70	66	calm	..	heavy thunder and rain in morning—day clear
27	45	74	70	..	clear	all day
28	48	80	66	S	..	..
29	50	76	72	calm	..	..
30	54	78	76	..	..	..
31	66	80	75	..	..	..

APRIL.

Days.	Morn.	Noon.	Night.	Wind.	Weather.	Remarks.
1	60	71	69	calm	cloudy	Red river rising
2	60	76	71	S.light	..	
3	61	75	68	calm	clear	
4	54	74	68	NE	..	smoky, pine woods on fire
5	44	67	61	calm	..	..
6	43	66	56	NE	..	foggy morning—day clear
7	44	68	61	NW.light	..	.. ..
8	45	72	72	calm	..	smoky
9	50	65	60	..	cloudy	.. —rain at night
10	50	72	66	..	clear	foggy morning—clear day
11	60	77	68	S.high	..	all day [river at a stand
12	66	73	70	S.light	cloudy	shower in the morning
13	56	68	63	NE	..	all day—river falling
14	57	61	56	N	..	..
15	52	58	50	NE	..	rain and showers all day
16	46	66	60	calm	clear	
17	44	70	64	SE	..	
18	60	61	63	..	cloudy	rain all day
19	71	71	69	S.high	..	drizzling all day
20	66	71	65	calm	..	.. ..
21	56	72	64	..	..	
22	58	72	72	..	..	
23	54	80	74	..	..	foggy morning
24	62	72	70	..	..	clear at noon
25	70	72	67	SE	..	thunder and rain all day
26	64	72	70	calm	..	
27	64	70	66	N	clear	Red river rising
28	50	72	68	calm	..	
29	58	68	70	SW	cloudy	rain and thunder all day
30	70	76	72	calm	clear	.. .. in even'g.

TS.

BER 2.

ME

Days.	
1	4
2	5
3	5
4	3
5	2
6	2
7	3
8	3
9	3
10	3
11	4
12	6
13	1
14	5
15	4
16	3
17	1
18	4
19	3
20	6
21	51
22	3
23	4
24	5
25	62
26	70
27	60
28	46
29	70
30	34
31	30

Days.	Morn.
1	40
2	49
3	40
4	24
5	28
6	47
7	24
8	12
9	20
10	29
11	28
12	32
13	38
14	49
15	34
16	31
17	29
18	34
19	45
20	49
21	58
22	60
23	50
24	46
25	58
26	[illegible]
27	[illegible]
28	25

from a sketch taken from a hill in the vicinity

KS

MORRIS COUNTY, N.J.

k, Mill Machin y &c.

Cylinder Machines.
Dryers.
Cutters.
Hogs.
Stuff Pumps.
Bars and Plates.
Lighters.
Dusters.
Rag Cutters.
Pulp Dressers.
Washers.
Stocks, Taps, & Dies.
Machines for boring Logs.
Mortising Machines.
Lathes, for Wood or Iron
Shears for cutting Iron.
All kinds of Castings &
Gudgeons
Shafts
Cogwheels

d forwarded.

MECHANICS' MAGAZINE,

AND

REGISTER OF INVENTIONS AND IMPROVEMENTS.

VOLUME VI.] AUGUST, 1835. [NUMBER 2.

ANCHOR FOR RAILWAY CARRIAGES ON INCLINED PLANES.

Fig. 1.

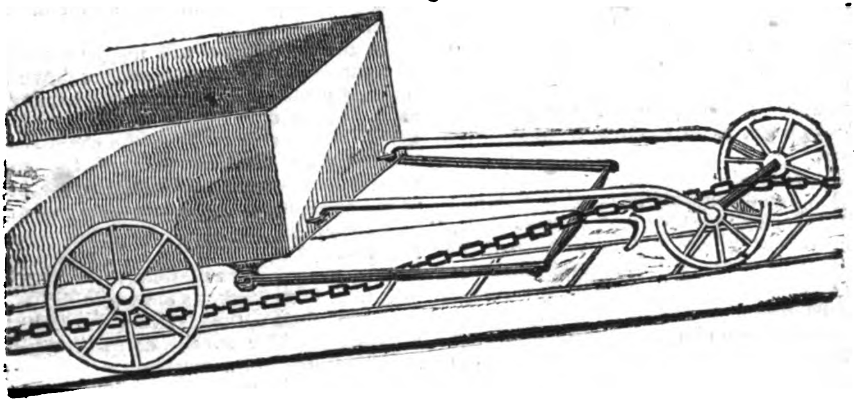


Fig. 2.

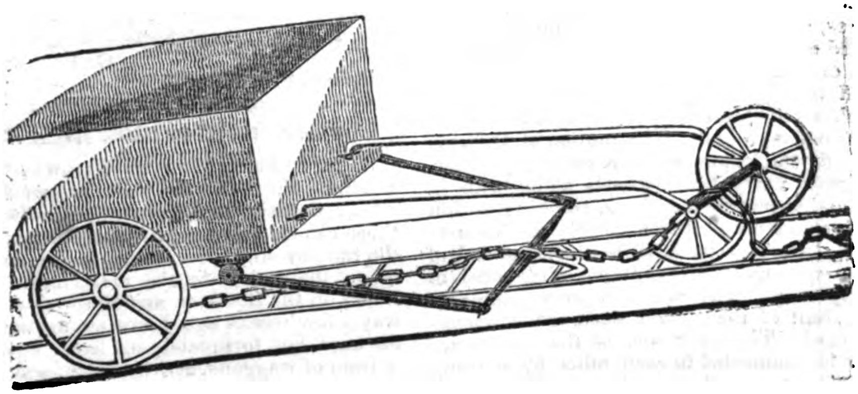


Fig. 4.

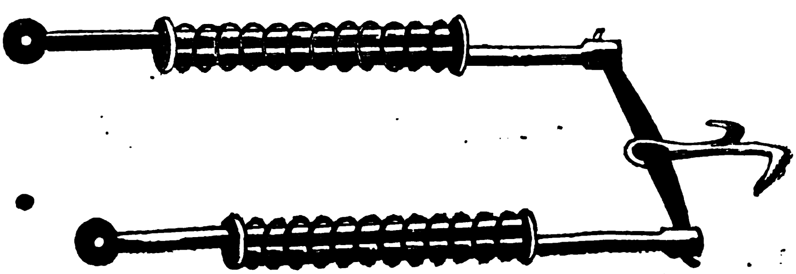
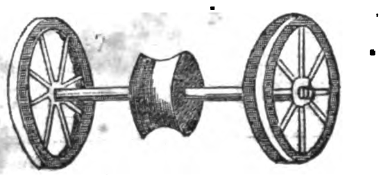


Fig. 3.



[From the London Mechanics' Magazine.]

ANCHOR FOR RAILWAY-CARRIAGES ON INCLINED PLANES.

Sir,—Having seen, from several articles in your Journal, that an effectual method of preventing the descent of carriages on an inclined plane, in the event of the chain breaking, is a desideratum, I am induced to forward you a plan for the purpose, which appears to me likely to meet the end in view.

The plan is as follows:

Let a double line of rails be laid down, about 18 inches asunder, and secured firmly in the ground in the middle of the path of the carriage, with holes through them at intervals of a yard; and through these holes let iron bars be put, connecting these new or supplementary lines of rails, so that the rails and bars together may present the appearance of a long iron ladder lying on the ground between the rails on which the carriage runs. Upon these rails a small pair of wheels, about 2 feet in diameter, or less, are to run, connected with the upper end of the carriage by means of two bars, 6 or 7 feet long, which are to hook on and off the carriage. Over the axle of these wheels the draft-chain is to go, to raise it from the ground. The motion of the carriage will, by means of the connecting-bars, always carry these wheels along with it. Another pair of iron bars, reaching within a few inches of these wheels, are then to be hooked or fastened to the same end of the carriage (but below the other bars), in any simple way that will insure the free descent of their outer ends when unsupported. The outer ends of these bars are to be connected to each other by a strong spring across them, sufficient to bear the sudden check in stopping the descent of the carriage; the draft-chain must go over and be hooked to this spring; and to the under side of the spring is to be fastened a strong hook, which the draft of the chain will keep off the ground, and allow it to pass freely up and down the inclined plane, without touching the cross-bars. If more elasticity is found necessary, than what the cross-spring of the drag-hook will give, the side bars of it connecting it with the carriage may be made with spiral springs, upon the principle of Salter's spring-balance; and the lower these bars are fastened on the carriage, the less quantity of upward pull there will be on the cross-bars and rails to disturb them in their bed.

Fig. 1 is a representation of a carriage, provided with such an appendage as I have described, in the act of ascending or descending an inclined plane. The draft-chain is on the stretch, and the drag-hook supported off the ground by the strain of the chain.

Fig. 2 shows the carriage with the draft-chain broken, and the hook anchored on one of the cross-bars, having fallen for want of support from the strain of the chain.

As the draft-chain will not be stretched so tight in transporting carriages down the inclined plane, or drawing empty carriages, as it will in drawing them up, it may be useful to be able to raise the chain somewhat higher than the axle of the small wheels, to compensate for the greater bend of the chain upon those occasions; this can be effected by having a moveable sheave to fix on the middle of the axle, with a deep groove on its circumference, over which the chain is to work, as shown in fig. 3.

Fig. 4 shows the draft-hook, with the drag-hook under it, the cross-spring and spiral-springs to the side-bars.

It is scarcely necessary to add, that after the carriages have been drawn up or let down the inclined plane, all the bars may be detached, and the rails left clear.

I am, sir, your obedient servant,

C. PUTLAND.

Dublin, Feb. 14, 1835.

[From the London Mechanics' Magazine.]

SAFETY APPENDAGE TO RAILWAY-CARRIAGES.—Sir: Of the various accidents which occasionally happen on railways, those caused by waggons being thrown off the rails by sticks or stones laying across or *on* the rails, are the most numerous. Being on the Stockton and Darlington railway a few weeks ago, I saw an *instance* of the kind, but fortunately no harm ensued. A train of waggons, heavily laden, was proceeding at the rate of about sixteen miles an hour, when one of the wheels of the foremost of the train came in contact with a piece of coal, which happened to be laying on the plate, and such was the force of meeting, that the waggon leapt two or three inches high. Fortunately, however, it alighted in its proper position on the rails; for, had it gone off the way, such was the velocity of the other waggons, that they must have been inevitably dashed to pieces, and the person attending them either killed or severely wounded. As it was, no further damage was experienced than a slight concussion, which was felt to the end of

the train; owing to the first waggon losing time by leaping, and the rest overtaking and striking against it. Being an eye-witness of this *almost* catastrophe, it naturally made me try to devise some plan to remedy the possibility of accident on that head, and the following was the result of my cogitations. On each side of the first waggon of the train, I would have a kind of shovel fixed, so hung as just to clear the rail, that it may cause no unnecessary friction. Now, were a stone, stick, or any thing else, laying on or across the way, it would be an utter impossibility for the waggon to run over it, as it would not come in contact with the wheel. The shovel would either throw it off the rails or push it forward. Even if a man should fall across the road, as sometimes happens, instead of having his legs cut off, he would be thrown on one side, and be but little if at all hurt. This shovel might be hung by an adjusting chain, and in cases of severe frost, or a slight fall of snow over-night, might be let down upon the rail, when it would prepare it for the progress of the vehicle.

I am, Sir, yours respectfully,

Wm. Pearson.

Bishop-Auckland, Nov. 4, 1834.

[Since the date of the preceding communication from Mr. Pearson, we have received another letter from him, in which he says: "About two days after I had sent you my proposed Safety Appendage for Railway-Carriages, an accident happened on the Stockton and Darlington railway, which I feel assured could *not* have happened had the plan there proposed been in use. The misfortune alluded to befel as follows: an engine, with a train of waggons, proceeding down the way at a rapid rate, came in contact with an old brake, which was laying across the rails, and by the concussion the engine was thrown off the road—the engine-man (James Cleasby) was killed, his brains being dashed out against the water-tank, and much damage was done besides. The proprietors of the railway were so convinced that the brake had been designedly laid across the way, that they offered a reward of twenty pounds on the conviction of the miscreant who did it; but, unhappily for the cause of justice and humanity, the 'foul deed' has not yet been brought to light. On hearing how the accident occurred, I felt convinced that the appendage I have proposed would have prevented it. It must either have pushed the brake before the engine, till the engineer became aware of the impediment, or have eventually shoved it off the road! The wheel *could not possibly* have come in contact with it, and therefore the engine *could not* have been thrown off the road!" Two plans for the prevention of such accidents, very similar to that of Mr. Pearson, were proposed by Sir George Cayley, Bart., and Mr. Suddington.—Ed. London Mechanics' Magazine.]

Visit to the Messrs. Reynolds' Establishment at Kinderhook, New-York.

To the Editor of the Mechanics' Magazine:

Sir,—As my entire mental constitution is so completely tuned, and adapted to mechanical operations, that I should almost take pleasure in being ground up in any establishment which consisted chiefly of machinery, you would naturally expect to find me visiting and reconnoitring and examining and philosophizing upon, in mass and in detail, every mechanical, and especially every machine using establishment, which comes in my way; or rather which I come in the way of, even if I have to go considerably out of my way to do it.

In one of these reconnoitring excursions, which I lately made to that part of the town of Kinderhook, distinguished in the Golden Knickerbocker day by the cognomen of Valatie, partly to examine the progress of mechanical improvements there and partly to visit my friends, the Reynoldses, of that place—for I scarcely need tell you that every man who excels in nice mechanical operations is my friend, or, at any rate, I am his—I saw some improvements which I think ought to be duly noticed in your useful Magazine.

But before going into the detail of of those improvements, I hope my said friends will pardon the liberty I take, in offering you some remarks on the persons by whom the improvements have been made. They are three brothers, who appear, at least to me, to possess in an uncommon share that kind of native intellect which, when properly cultivated, becomes what is commonly called mechanical ingenuity. They are yet in early life, and have served regular apprenticeships at those branches of business, which, when combined together, embrace all the operations of machine making. They are united together, not only by the strongest tie of consanguinity, but by a congeniality of mind rarely to be met with in three members of the same family. They have, from the earliest

periods of their apprenticeships, devoted their leisure hours industriously to the acquirement of such branches of science as might aid them in future business; and the joint result of their studies amounts, I should think, to a stock of mechanical science, perhaps not surpassed, if equalled, in any other establishment of the kind in this country. As their seasons for study must have been limited, it would seem they have so managed their subjects that, whenever one is at a loss, another is ready to prompt him. By the joint avails of their industry, previously to their uniting, they had acquired the pecuniary means of procuring an excellent water privilege, erecting shops, &c., to make a very respectable beginning. Every article in their shops exhibits a degree of skill in plan and arrangement, and of taste and neatness of workmanship, which are of the highest order. I am confident the most competent judge would, upon critical examination, pronounce their establishment an honor to themselves and the country.

But to return to the improvements.

The first which attracted my notice is a saw-mill, on a scale about half the size of the common saw-mill, but which may be as suitably applied to use on one scale as another. I think any person with a mechanical eye, who sees it, will concede that the propelling power necessary for a saw-mill of the common form and size, with one saw, would on this plan drive four of the same size. I will endeavor to give you a brief description, together with a diagram, which will, I think, make it clearly understood.

The saws are held and operated by two balance beams or walking beams, similar to those used in the common steam engine. These beams are placed horizontally one above the other, exactly parallel, and their distance from each other about twice the length of the saw, more or less. Each beam is supported in the middle by a strong fulcrum or axis, resting on its pivots or bearings; which pivots or bearings are supported in the following manner.

The bearings of the lower axis rest upon strong side timbers of an oblong frame, about half way from the bottom to top, which frame is to sustain on its top the carriage and log or other timber to be sawed, with the necessary apparatus and fixtures for fastening the log, and moving it forward against the saw.

The axis of the upper beam is supported in proper boxes in two hangers or timbers, projecting downward from the framework of the building above, and must of course be securely braced.

On each end of each of these beams is a segment of a circle, the radius of which is exactly half the length of the beams; and each segment will contain about 70 or 80 degrees of a circle, more or less. Each segment has a flat steel spring, about the length of the periphery of the segment, and as wide as the thickness of the same, and the thickness of the springs about one-third or one-half that of the saw. One end of each of these springs is attached to the outer end of one of the segments, that is, to the lower end of the lower segments and to the upper end of the upper segments. The faces of the segments being made smooth, the springs will, of course, when bent to them, lie flat.

It will be readily perceived, that if the inner or approximate ends of the springs at each end of each beam, that is, a top spring and a bottom spring at each end of the beams, were connected together, in any manner so as to draw them tight, and the beams were, at the same time, placed in a parallel and horizontal position, the string, or whatever connected the top and bottom beams, with their respective springs, together, would make part of a tangent line from the centre of one segment to the centre of the other. When the beams are thus placed, if the ends are moved alternately up and down, the lines of connection between the top and bottom beams and segments will move exactly up and down, without any lateral motion whatever. If, then, these two connecting lines consist of two saws, attached to the aforesaid springs, the saws will move up and down as accurately as if carried up and down with a saw-gate, and perhaps more so. And if the power of a crank motion be applied to the centre end of either of the segments, both saws will be put in operation, one going up as the other goes down, and *vice versa*.

These saws may stand with their teeth

in any direction, either to cut parallel with the beams or at right or any other angle. We have then two complete saw-mills, operated by the same power which would operate one; and a gang of any number of saws may be operated in the same manner. If, however, the saws are set so as to cut parallel with the beams, one saw will interfere with the other; it will be necessary therefore to have the saws cut at right angles with the beams, and then, of course, the two logs can move parallel with each other.

By this plan, the weight necessarily moved up and down with the saws will be but a small part of the weight of the common saw-gate, and one saw completely balances the other, so that the power of a child will give the saws the necessary motion, except the resistance produced by cutting.

As the moving the log and other subservient operations may be effected as in the common saw-mill, no description is therefore necessary. The diagram will show the mode of hanging and operating the saw, which forms the basis of the improvement.

Several other improvements found in the same establishment will be noticed hereafter. S. B.

We are very much obliged to "A Young Engineer" for the following communication, and hope to hear again from him.

To the Editor of the Mechanics' Magazine:

SIR,—Having been employed in November last to ascertain the number and capacity of the steam engines then in use in this city, for the various manufacturing purposes with which our city abounds, and thinking that an abstract would be interesting to many of your readers, I have prepared the following, namely:

Whole number of engines in daily operation, 76*; aggregate number of horse powers, 858; aggregate number of gallons of water used per day, of 10 hours, 60,385.

Which, in the event of your deeming worthy of an insertion in your columns, will not only be a source of gratification to me, in having added to your useful work, but will be the means of eliciting some further contributions, at no very distant period, from A YOUNG ENGINEER.

New-York, July 20, 1835.

* From 8 to 12 have been erected since.

[From the London Penny Magazine.]

MR. JOHN LOMBE, AND THE SILK-THROWING MACHINERY AT DERBY.—The Lombes were originally manufacturers at Norwich, but removed to London, and became silk throwsters and merchants there. There were three brothers, Thomas, Henry, and John; the first was one of the sheriffs of London at the accession of George II. in 1727, on which occasion, according to custom, the chief magistrate was created a baronet, and Mr. Lombe was knighted. The second brother, who was of a melancholy temperament, put an end to his existence before those plans were developed which connected the name of Lombe with one of the most important manufactures of the country.

The Messrs. Lombes had a house at Leghorn under the firm of Glover & Unwin, who were their agents for purchasing the raw silk which the Italian peasantry sold at their markets and fairs to the merchants and factors. There were many other English houses at Leghorn, Turin, Ancona, and other parts of Italy, chiefly for exporting silk to England, in part return for which numerous cargoes of salt fish were and still are received from our ports for the consumption of the Italians during their Lent and other fasts. It was at that time customary for the English merchants engaged in the Italian trade to send their apprentices and sons to the Italian ports to complete their mercantile education, by acquainting themselves on the spot with the details of their peculiar line of business. It was professedly in compliance with this custom, but with a deeper ulterior view, that the youngest of the brothers, Mr. John Lombe, who at that time was little more than twenty years of age, proceeded to Leghorn in the year 1715.

The Italians had at that time become so much superior to the English in the art of throwing silk, in consequence of a new invention, that it was impossible for the latter to bring the article into the market on equal terms. This state of the trade induced the Lombes to consider by what means they might secure the same advantage which their improved machinery gave to the Italians; and the real view of the younger brother, in proceeding to Italy, was to endeavor to ob-

tain such an acquaintance with the machinery as might enable him to introduce it into this country. The difficulties in the way of this undertaking were very great, and would have appeared insurmountable to any but a person of extraordinary courage and perseverance. We find these difficulties thus stated in the paper which Sir Thomas Lombe printed for distribution among the members when he applied to Parliament for the renewal of his patent. One at least of these printed papers has been preserved, and has been lent us for the present occasion. It is there said, that "the Italians having, by the most judicious and proper rules and regulations, advanced and supported the credit of the manufacture, have also, by the most severe laws, preserved the mystery among themselves for a great number of years, to their inestimable advantage. As, for instance, the punishment prescribed by one of their laws for those who discover, or attempt to discover, any thing relating to this art, is death, with the forfeiture of all their goods, and to be afterwards painted on the outside of the prison walls, hanging to the gallows by one foot, with an inscription denoting the name and crime of the person; there to be continued for a perpetual mark of infamy."

The young Lombe, however, was not to be deterred by the danger and difficulty of the enterprise. On his arrival, and before he became known in the country, he went, accompanied by a friend, to see the Italian silk works. This was permitted under very rigid limitations. No person was admitted except when the machinery was in action, and even then he was hurried through the rooms with the most jealous precaution. The celerity of the machinery rendered it impossible for Mr. Lombe to comprehend all the dependencies and first springs of so extensive and complicated a work. He went with different persons in various habits, as a gentleman, a priest, or a lady, and he was very generous with his money; but he could never find an opportunity of seeing the machinery put in motion, or of giving to it that careful attention which his object required. Despairing of obtaining adequate information from such cursory inspection as he was thus enabled to give, he bethought himself of associating with the clergy, and being a man of letters, he succeeded in ingratiating himself with the priest who confessed the family to which the works belonged. He seems to have opened his plans, partly at least, to this person, and it is certain that he found means to obtain his co-operation. According to the scheme which they planned between them, Mr. Lombe disguised himself as a poor youth in want of employment. The priest then introduced him to the directors of the works, and gave him a good character for honesty and diligence, and described him as inured to greater hardships than might be expected from his appearance. He was accordingly engaged as a fillatoe-boy, to superintend a spinning engine so called. His mean appearance procured him accommodation in the place which his design made the most acceptable to him,—the mill. While others slept, he was awake, and diligently employed in his arduous and dangerous undertaking. He had possessed himself of a dark lantern, tinder box, wax candles, and a case of mathematical instruments: in the day time these were secreted in the hole under the stairs where he used to sleep; and no person ever indicated the least curiosity to ascertain the extent of the possessions of so mean a lad. He thus went on making drawings of every part of this grand and useful machinery; the priest often inquired after his poor boy at the works, and through his agency Lombe conveyed his drawings to Glover and Unwins; with them models were made from the drawings, and dispatched to England piecemeal in bales of silk. These originals are still, we believe, preserved in the Derby mills.

After Lombe had completed his design, he still remained at the mill, waiting until an English ship should be on the point of sailing for England. When this happened, he left the works and hastened on board. But meanwhile his absence had occasioned suspicion, and an Italian brig was dispatched in pursuit; but the English vessel happily proved the better sailer of the two, and escaped. It is said that the priest was put to the torture; but the correspondent of the "Gentleman's Magazine," to which we are indebted for most of the facts we have stated, says that after Mr. Lombe's return to England, an

Italian priest was much in his company; and he is of opinion that this was either the priest in question, or at least another confederate in the same affair. Mr. Lombe also brought over with him two natives accustomed to the manufacture, for the sake of introducing which he had incurred so much hazard.

After his return Mr. John Lombe appears to have actively exerted himself in forwarding the works undertaken by him and his brother, Sir Thomas, at Derby; but he did not live to witness their completion. He died on the premises, on the 16th of November, 1722, in the 29th year of his age. The common account of his death is, that the Italians, exasperated at the injury done to their trade, sent over to England an artful woman, who associated with the parties in the character of a friend; and having gained over one of the natives who originally accompanied Mr. Lombe, administered a poison to him of which he ultimately died.

We recur to Sir Thomas Lombe's statement, already quoted for the most authentic particulars respecting the progress of the work. The document itself is entitled, "A Brief State of the Case relating to the machine erected at Derby, for making Italian Organzine Silk, which was discovered and brought into England with the utmost difficulty and hazard, and at the sole expense of Sir Thos. Lombe." It commences with stating the capabilities of the machine. "This machine performs the work of making Italian organzine silk, which is a manufacture made out of fine raw silk, by reducing it to a hard twisted, fine, and even thread. This silk makes the warp, and is absolutely necessary to mix with and cover the Turkey and other coarser silks thrown here, which are used for shute; so that without a constant supply of this fine Italian organzine silk, very little of the said Turkey and other silks could be used, nor could the silk-weaving trade be carried on in England. This Italian organzine (or thrown) silk has in all times past been bought with our money, ready made (or worked) in Italy, for want of the art of making it here; whereas now, by working it ourselves out of fine Italian raw silk, the nation saves nearly one third part; and by what we make out of fine China raw silk, above one half of the price we pay for it ready worked in Italy." The paper goes on to state, that "the machine at Derby has 97,746 wheels, movements, and individual parts, (which work day and night,) all which receive their motion from one large water wheel, and are governed by one regulator; and it employs 300 persons to attend and supply it with work." After stating the difficulties which had been surmounted in introducing this improvement, the paper thus concludes: "Upon the introduction of which [this improvement], his late most gracious Majesty granted a patent to the said Sir Thomas Lombe, for the sole making and use of the said engines in England, for the term of fourteen years. Upon which he set about the work and raised a large pile of building upon the river Derwent at Derby, and therein erected the said machine; but before the whole could be completed, several years of the said term were expired. Then the King of Sardinia, in whose country we buy the greater part of our supply of organzine silk, being informed of his success, prohibited the exportation of Piedmontese raw silk; so that before the said Sir Thos. Lombe could provide a full supply of other raw silk proper for his purpose, alter his engine, train up a sufficient number of workfolk, and bring the manufacture to perfection, almost the whole of the said fourteen years were run out. Therefore, as he has not hitherto received the intended benefit of the aforesaid patent, and in consideration of the extraordinary nature of his undertaking, the very great expense, hazard, and difficulty, he has undergone, as well as the advantage he has hereby procured to the nation at his own expense, the said Sir Thomas Lombe humbly hopes the parliament will grant him a further term for the sole making and using his engines, or such other recompense as in their great wisdom shall seem meet."

The Parliament considering the matter of much public importance, thought it best to give him a grant of £14,000, on condition that the invention should be thrown open to the trade, and that a model of the machine should be deposited in the Tower of London for public inspection. It is commonly stated that Parliament refused

to extend the patent, and granted the money to soften their refusal; but we have seen that Sir Thomas himself suggested some "other recompense" than an extended patent as an alternative. In the course of time similar mills began to be erected in different parts of the country; but in consequence of the difficulties that were experienced in procuring Italian raw silk of the proper size for organzine, (the exportation of which was prohibited by the Italians,) and also because the mills happened subsequently to find employment for other purposes, the quantity worked into organzine, in this country, bore for many years no proportion to the imports from Italy. The manufacture has, however, been since revived and improved. In consequence of which it is now carried on to a very considerable extent, not only in Derby, but in other parts of the country.

The mill erected by Sir Thos. Lombe stands upon an island, or rather swamp, in the Derwent, about 500 feet long and 52 wide. The building stands upon huge piles of oak, double planked, and covered with stone-work, on which are turned thirteen stone arches, that sustain the walls. Its length is 110 feet, its breadth 39, and its height 55 feet. It contains five stories. In the three upper are the Italian winding engines, which are placed in a regular manner across the apartments, and furnished with many thousand swifts and spindles, and engines for working them. In the two lower floors are the spinning and twist mills, which are all of a circular form, and are turned by upright shafts passing through their centres and communicating with shafts from the water wheel. The spinning mills are eight in number, and give motion to upwards of 25,000 reel-bobbins, and nearly 3000 star-wheels belonging to the reels. Each of the four twist mills contains four rounds of spindles, about 389 of which are connected with each mill, as well as numerous reels, bobbins, star-wheels, &c. The whole of this elaborate machine, though distributed through so many apartments, is put in motion by a single water wheel, twenty-three feet in diameter, situated on the west side of the building. All the operations, from winding the raw silk to organizing or preparing it for the weavers, are performed here. The raw silk is chiefly brought in skeins or hanks from China and Piedmont. The skein is, in the first instance, placed on a hexagonal wheel, or swift, and the filaments which compose it are regularly wound off upon a small cylindrical block of wood, or bobbin. It is the work of five or six days to wind a single skein, though the machine be kept in motion for ten hours daily, on account of the amazing fineness of the filaments of which it consists. The silk, when thus wound off upon the bobbins, is afterwards twisted by other parts of the machinery, and is then sent to the *doublers*, who are chiefly women stationed in a detached building. Here four, seven, or ten threads, are twisted into one, according to its intended size, the fine kind going to the stocking weavers, and the others to different manufacturers. Other mills erected more recently at Derby, on a similar principle, greatly surpass this in their machinery, and efficiency; but the old mill must continue to be regarded with peculiar interest, as the first establishment of the kind erected in this country.

[For the Mechanics' Magazine.]

Speedwell Iron Works.—Speedwell is a small village situated on the Whippany river, about one mile from the pleasant town of Morris, Morris county, N. J., and celebrated for its manufactories of machinery. Located as it is in the very heart of an iron region, and supplied with an unfailing water power, it has advantages for the making of machinery which few works possess. They have been in operation thirty years, and have acquired, from the superior quality of the work, in strength, durability, and finish, extensive patronage and celebrity. The enterprising and intelligent proprietors, S. Vail & Son, having gradually enlarged the works from their commencement, and improved the machinery as the times demanded, have spared no pains in providing the manufactories with every kind of apparatus which is necessary for the execution of the most difficult pieces of work, and with the greatest care and dispatch. At present the works consist of several shops, in which machinery in its various stages is made. The first is the forging department, where, by peculiar facilities

and helps, afforded by the locality of the establishment, its water power, driving a trip hammer and also a pair of bellows, supplying all the fires with wind, its cranes and railways, is made the heaviest and most unyielding pieces of machinery. The next branch is its finishing departments, which are three. Every advantage is also here taken of its water power, and its apparatus for finishing is simple and effective. It has also a brass-foundry, and an iron-foundry erecting, a factory for spinning cotton not yet finished, a sash factory in full operation, where the mortices, tenons, &c. are made by machinery, and a saw-mill. The village is quite romantic, and its scenery enchanting—surrounded on every side by steep and high hills, overlooking the busy scenes below, and the spacious lake which spreads before the eye in beauty, embosomed between two large hills, whose verdant and woody sides slope to the water's edge. [For a view of this establishment see engraving.]

Silversmith's Portable Forge.—We were much pleased with the examination, at the machine shop of Mr. G. N. Miner, No. 30 Gold street, of a *Portable Forge* for the use of jewellers and others who require a small manageable fire. It consists, first, of a cast iron fireplace, much resembling a Franklin stove, with a pot, about the size and shape of the crown of an old-fashioned quaker hat, inverted, and attached to the bottom of the hearth of the stove, into which is inserted a tin air pipe, leading from the bellows, contained in a box of 37 inches long, 24 inches wide, and 16 inches deep, upon the top of which the forge or stove stands, occupying very little space, and it may be moved by one man to any part of the shop. The bellows is put in motion by the foot of the man who uses the forge. This very convenient apparatus was invented, we are informed, by Mr. ———, of Peekskill, Westchester county, New-York, and one of them may be examined at No. 30 Gold street, to which we would call attention.

[For the Mechanics' Magazine.]

Mr. Burden's Spikes. — The public has already had the means of knowing that the above named enterprizing individual invented, some years since, a machine for making spikes of wrought iron, chiefly for the purposes of being used in constructing ships and railroads; but their value, compared with other spikes, seems to be but very sparingly known. These spikes, to any competent judge, will show themselves to be far superior to any spikes ever manufactured, or which can be manufactured for the above purposes, for the following reasons. The iron being selected by Mr. B. himself, and in large quantities of the first quality, no other being used,* its uniform excellence must infinitely surpass that of common spikes, which are made of such small lots of iron as come to hand promiscuously; the body of these spikes being of exactly even and uniform size, and without hammer strokes, when once entered they have no tendency to split the wood, and, having a square chisel shaped edge, they cut their passage instead of forcing it.

But Mr. B. is emphatically an experimentalist, and he wished to test the comparative value of his spikes by some precise data. He wished to ascertain first with what degree of safety his spikes might be driven into wood without splitting; second, what was the tenacity of the iron; and third, what power it would require to draw them out.

To test the first point, he took a piece of seasoned white oak joist, 3 by 6 inches, and sawing off 3 inches, produced, of course, a piece 3 inches square and 6 inches long, but with the grain running crosswise. In one end of this block, he entered, without boring, the point of a spike 5 inches long, with the edge of its point across the grain, and drove in the whole length without splitting the block.

To ascertain the second and third points, he drove another and similar spike into a similar block, leaving its head a little distance out, and securing the block in a firm situation, and griping the head by a strong instrument similar to a pair of wire tongs, he suspended to the tongs 100 56-pound weights, equal to 5600 pounds, and these neither breaking the spike nor

drawing it out, he took a sledge and struck forcibly upon the apparatus attached to the head of the spike, when it drew out and left the spike and the wood unbroken.

These experiments were made at the store of Messrs. I. & J. Townsend, in this city, in presence of the President and Directors of the Albany and Schenectady Railroad Company, and if they do not remove all doubts as to the superiority of these spikes for ships and railroads, I know not what would. S. B.

Albany, June 15, 1835.

[For the Mechanics' Magazine.]

TABLE,

Showing the proper number of turns or twists to an inch in Cotton Warp for every degree of fineness, or number of skeins to the pound, from 1 to 200.

1	5.	31	27.83	61	39.05	91	47.69
2	7.07	32	28.28	62	39.37	92	47.95
3	8.66	33	28.72	63	39.68	93	48.22
4	10.	34	29.15	64	40.	94	48.47
5	11.18	35	29.57	65	40.3	95	48.73
6	12.24	36	30.	66	40.62	96	48.98
7	13.22	37	30.41	67	40.92	97	49.24
8	14.14	38	30.82	68	41.28	98	49.49
9	15.	39	31.22	69	41.53	99	49.74
10	15.81	40	31.62	70	41.83	100	50.
11	16.58	41	32.01	71	42.12	105	51.23
12	17.32	42	32.4	72	42.42	110	52.43
13	18.2	43	32.83	73	42.72	115	53.61
14	18.72	44	33.16	74	43.01	120	54.77
15	19.36	45	33.54	75	43.3	125	55.90
16	20.	46	33.91	76	43.58	130	57.
17	20.61	47	34.26	77	43.87	135	58.07
18	21.21	48	34.71	78	44.13	140	59.16
19	21.79	49	35.	79	44.41	145	60.2
20	22.35	50	35.35	80	44.72	150	61.23
21	22.91	51	35.7	81	45.	155	62.24
22	23.45	52	36.05	82	45.27	160	63.24
23	23.97	53	36.41	83	45.55	165	64.22
24	24.13	54	36.74	84	45.82	170	65.19
25	25.	55	37.08	85	46.09	175	66.12
26	25.5	56	37.41	86	46.36	180	67.08
27	25.98	57	37.71	87	46.63	185	68.
28	26.45	58	38.07	88	46.9	190	68.92
29	26.92	59	38.4	89	47.17	195	69.82
30	27.15	60	38.72	90	47.4	200	70.86

Mr. S. Blydenburgh: Sir,—A difficulty is often experienced in cotton spinning manufactories, not only at their first starting, but frequently afterwards, owing to the overseer not knowing how to calculate the precise quantity of twist for any given number or size of yarn. To remedy this difficulty, you may insert, if you think proper, the enclosed table in the Mechanics' Magazine, which will show the number of turns or twists per inch, to make the yarn to be spun agree in its proportion of twist with the sample given.

Example. The most approved quantity of twist, or rate of twisting, within the circle of my acquaintance, is 20 turns per inch for warp yarn No. 16, and other numbers in proportion. Now, to come at this proportion, I extract the square root of the number to be spun and multiply it by 5, and the product is the number of turns required. Suppose the number of the yarn required to be spun is 64—then the square root of 64 is 8, which, multiplied by 5, gives 40 for the appropriate number of turns to the inch for yarn No. 64—and the same of any other number.

I have given the fractional parts of the number of turns in decimals, omitting what is over 2 places, or omitting thousandth parts of a turn, as so small a fraction of a turn can be of no consequence. Your obedient servant,

Augustus Green.

Scituate, R. I.

Remarks.—The communication and table from Mr. Green, I think, cannot fail to be acceptable to cotton manufacturers, as I have found but very few overseers of spinning rooms who knew how to come at the knowledge it contains. Mr. G.'s table, I would notice, however, giving a little more twist than I have been in the habit of giving, when engaged in cotton manufacturing, but this is mere matter of opinion. I have no doubt that 20 turns to the inch to No. 20, which is the proportion of twist that I have given, will make rather the smoothest goods, but 20 turns to No. 16 will have the advantage in strength; but this table can be adjusted to any quantity of twist. The principle is, that an inch of cotton thread is a cylinder an inch long, and the solid contents of two cylinders of the same length are to each other as the square of their diameters. Hence, if a thread of No. 16 be of a given diameter,

one of half the diameter would have but one fourth of the weight, and consequently would be No. 64. But the quantity of twist requires to be in the direct proportion to the diameter.

In Mr. G.'s table, he allows 20 turns to the inch of No. 16, which is equal to the square root of 16, multiplied by 5, and the proportion will hold good with any other number by multiplying its root by the same multiplier, and the relative quantity of twist may be varied by using any other multiplier. For example: If it were wished to give No. 16 only 16 turns, then as the root of 16 multiplied by 4 equals 16, the root of any other number, multiplied by 4, would give the same proportion of twist. If instead of multiplying by 4 or by 5, any intermediate fractional part between 4 and 5, as 4·3, or 4·5, be used, the twist may be varied accordingly. Multiplying the root of the number of yarn by 4·5, or 4½, gives a small fraction over 20 turns to the inch of yarn No. 20.

S. Blydenburgh.

[From the Apprentice's Companion.]

Mr. S. Blydenburgh: Sir,—Deeming it not an unimportant matter, I take the liberty of presenting you a few remarks, intended for the Apprentice's Companion, respecting the formation of our Apprentices' Society, and the establishment of a reading room and apprentices' library in Albany, hoping the example may induce others to do likewise.

Being in the city of Philadelphia in 1829, I was invited by a friend to accompany him, to hear an address by Rev. Mr. Bacon, to the congregation of apprentices of that city, and I accordingly went, and can truly say I never before witnessed a scene to me so pleasingly interesting. To see 150 young men, conducting not only with the utmost decorum, but with apparent marks of sincere devotion; and when the service ended, instead of rudely rushing to the doors, to see who would get out first, to see them rise in small numbers at a time, and walk out in the most respectful manner, was, to me, not only a pleasing but a charming sight.

On returning home, fired with a zeal for the youth of our city, I made application to the Common Council for a room in the Lancaster building, which was granted and fitted up by them. A society was formed, and a reading room opened every night in the week; since which time the affairs of the society have gradually, though not steadily, progressed to their present state. After being closed one year, the library was removed to its present location, in February, 1831. From this time to the close of the year, 1754 books were drawn out; in 1832, 5000; in 1833, 11,343; in 1834, 10,276; in 1835, up to June 31, 4,831; and is still increasing in magnitude and effect.

James S. Gould, Librarian.

[From the Apprentice's Companion.]

Mr. Editor,—In your second number I addressed a few remarks to apprentices on the importance of studying grammar; permit me now to address to that important class of community a few plain, practicable observations. My remarks and advice may appear trite, but I hope they will be well pondered by those for whom they are intended. At present there seems an awakening in our country to the moral improvement of mechanics. If this is so, (and I believe it to be the case,) I hope a word of caution to apprentices will not be taken amiss by any one: it is the danger of considering *that* mental improvement which whets the mind for disputation on abstract questions. This, instead of enlightening, bedizens the mind. To become fond of it, and be much engaged in controversies of this kind, is perverting the noblest faculty bestowed on man by his Creater, especially disputations on religion. Religion, properly understood, is chastened thinking and feeling; and how can these be debateable? Study the example and precepts of Christ, as you find them yourselves in the New Testament, and avoid the worse than useless sectarian disputations. So far is it from my aim to dissuade from, that I most earnestly recommend, regular attendance at public divine worship; but avoid denunciating sectarian pulpits. They debase the heart, and destroy the good will of man to man.

There is an old saying, that "when the boy assumes the man, the man will play the boy." Another, "a forward boy makes a froward man." I quote these old sayings, not to discourage boys from endeavoring to store their minds with as much of the knowledge that appertains to, and can be expected from, men only; but to guard them against the too common fault of supposing themselves possessed of that after which they have only commenced the pursuit. An ancient philosopher has said, "I have lived to threescore years and ten to learn to know that I know nothing." What presumption, then,

for boys to flatter themselves that they know too much to be taught by men! That some boys have thus deceived themselves to their injury, nay, sometimes to their destruction, my own observation can bear testimony.

"It is much easier to learn than to unlearn bad habits:" this the experience of life teaches. How necessary, then, for every boy, when he first leaves the parental roof to learn a trade by which he hopes to make a comfortable livelihood, that he should so form his habits as to insure success; and this can be done only by conducting himself in such a way as to command respect for himself, and by cherishing the noble feeling of adding respectability to his calling.

An important consideration for a boy, when he first enters a shop, next to obtaining the good opinion of his master, is the conciliating that of the journeymen; for he ought to know, that it is not in the power of a master to teach himself, directly, all the minutiæ of his business to every apprentice he may have. The boy must observe for himself; and any thing he does not understand, he can learn from journeymen, or older apprentices, by a frank inquiry, if he shows in his conduct that he is deserving of it. Almost every man, whatever his general deportment may be, is gratified to give information to a boy, when it is asked with sincerity, and an evident desire for improvement. When advice is given, although it may appear at the time that not much knowledge has been imparted, receive it kindly and thankfully; in after years you may highly appreciate it.

It has been said, "There is no royal road to science;" nor can a man be a good mechanic by intuition. The proverb, "Little strokes fell great oaks," may be truly applied to the acquisition of mechanical knowledge, which, to be permanently useful, must be attained gradually. This fact ought not to dishearten the young apprentice, for he will soon find that every new acquisition of knowledge in his trade is a new incentive to exertion, and that progressing in knowledge is the most solid happiness of life.

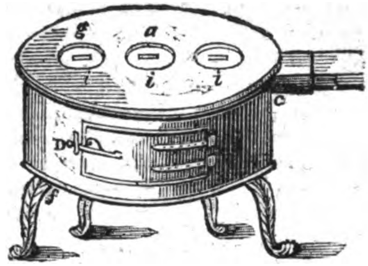
Giving each other nicknames is a vulgar habit to which boys are much addicted. It should be avoided, for it frequently causes wrangling and fighting, and destroys friendships that might otherwise be advantageously cemented through life.

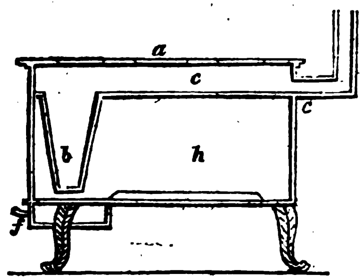
Avoid also the frequent use of by-words: they may be, and many of them are, harmless; but the habit is vulgar, and degrades you in the estimation of the more thinking part of the community. Above all, do not get in the habit of interlarding your conversation with oaths: this, to say nothing of the blasphemy, is detestable in every respect; nothing is more grating to the feelings of a man of sense. "Swear not at all," is a command in Holy Writ. Read the sacred volumes with attention; maxims are there to be found more profitable in life, if correctly understood and acted up to, than can be found any where—every where else.

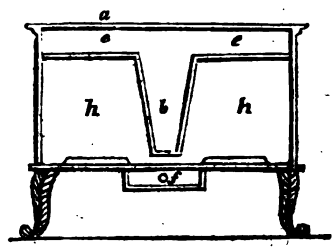
A MECHANIC.

NUMBER OF LIVING BEINGS. — The immense multitude of animated beings which people the earth, and the ample provision that is made for their necessities, furnish irresistible evidence of the divine goodness. It has been ascertained that more than sixty thousand species of animals inhabit the air, the earth and the water, besides many thousands which have not come within the observation of the naturalist. On the surface of the earth there is not a patch of ground, nor a portion of water, a single shrub, tree, or herb, and scarcely a leaf in the forest, but what teems with animated beings. How many hundreds of millions have their dwellings in caves, in the clefts of rocks, in the bark of trees, in the ditches, in the marshes, in the forests, the mountains, and the valleys! What innumerable shoals of fishes inhabit the ocean, and sport in the seas and rivers! What millions of millions of birds and flying insects, in endless variety, wing their flight through the atmosphere above and around us! Were we to suppose that each species, on an average, contains four hundred millions, there would be twenty four billions of living creatures belonging to all the known species inhabiting the different regions of the world, besides the multitude of unknown species yet undiscovered, which is 30,000 times the number of all the human beings that people the globe. Besides these, there are multitudes of animated beings which no man can number, invisible to the unassisted eye, and dispersed through every region of the earth, air, and seas. In a small stagnant pool, which in summer appears to be covered with green scum, there are more microscopic animalcules than would outnumber all the inhabitants of the earth. How immense then must be the collective number of these creatures throughout every region of the earth and atmosphere! It surpasses all our conceptions. Now it is a

fact, that from the elephant to the mite—from the whale to the oyster—from the eagle to the gnat, or the microscopic animalcule—no animal can exist without nourishment. Every species too requires a different kind of food. Some live on grass, some on shrubs, some on flowers, and some on trees. Some feed on the roots of vegetables, some on the stalk, some on leaves, and some on the fruit, some on the seed, some on the whole plant; some prefer one species of grass, some another. Yet such is the undoubted munificence of the Creator, that all the myriads of sentient beings are amply provided for and nourished by his bounty! "The eyes of all these look unto him, and he openeth his hand, and satisfieth the desires of every living thing." He hath so arranged the world, that every place affords the proper food for all the living creatures with which it abounds. He has furnished them with every organ and apparatus of instruments for gathering, preparing, and digesting their food, and has endowed them with admirable sagacity in finding out and providing their nourishment, and in enabling them to distinguish between what is salutary and what is pernicious. In the exercise of these faculties, and in all their movements, they appear to experience a happiness suitable to their nature.







THE BRUGES STOVE, as improved by Messrs. Cottam and Hallen. By Mr. Edward Cottam.—I send you sketches (figs. 1, 2, 3,) of the Bruges stove, as manufactured by Cottam and Hallen, who have found it to answer fully the statement given by them of it in your Encyclopedia of Achitecture. It will do more with a given quantity of fuel than any other stove, having the means of stewing, boiling, broiling, roasting, and baking, at one and the same time, with a small quantity of coke or cinders from any other fire.

It is simple in form, and there is not the slightest difficulty in its use. The holes in the top may be arranged as is found most convenient for the situation in which the stove is to be placed, either in a line, as in the sketch, (fig. 1,) or in the form of a triangle. One thing is indispensable for the proper action of this stove, and that is a good draught. It must, therefore, have a separate flue.

In figs. 1, 2, 3, *a* is the top of the stove; *b* is the fire pot; *g* is the hole for feeding the fire pot; *f* is an ash drawer; *c* is the flue; D is the oven door; *h* is the oven; *e* is a space for the fire to pass to the flue *c*, and for heating the whole of the top plate, any part of which will produce sufficient heat for culinary purposes; *i i i* are lids, which may be taken off, and the battery of stew-pans, or boilers, will then be in contact with the flame. A grid-iron fits on any of these openings, which has the advantage of not smoking the article broiled, the draught being downwards.—[Loud. Arch. Mag.]

MALLEABLE IRON.—Though the manufacture of iron belongs to the department of useful arts, the process by which refuse and scraps of all kinds are converted into a malleable mass, is rightly embraced under chemical manipulations. Within a comparatively little time, a costly establishment has grown up at East Boston, called the Malleable Iron Manufactory, in which it is generally understood that various cutlery is to be made from such ap-

parently worthless materials as have here been adverted to. It was remarked in our hearing, that an old door hinge, originally cast iron, had been converted into a razor; and that a certain individual, whose name had not been ascertained by the gentleman who gave the above information, alone possessed the skill of performing these apparently impossible transmutations of a brittle, irregular grained cast metal, into finely tempered cutting instruments.

From the magnitude of the preparations in progress, as it regards buildings, the erection of a wharf and dwellings for the operatives, it is very certain that an active business is contemplated. By looking into the third volume of the Scientific Tracts, as well as the Museum of Arts, it appears to us that all that is known of the best methods of managing iron and steel is plainly exhibited. The carbonization of the article is the object, and the working-secret at this manufactory must consist, therefore, in effecting this in a speedier and less expensive manner than is at present known to practical chemists. —[Scientific Tracts.]

Hydrostatic Pressure on the Eyes of Whales.—Admitting a cubic foot of fresh water weighs sixty-five pounds, and the same measure of sea water, sixty-six and a half, the pressure on the bodies of marine animals must indeed be great. Were a cubic foot of the latter to weigh exactly sixty-six pounds, at the depth of 8400 feet, the pressure must be the enormous weight of 554,400 pounds. Whales have occasionally run out fourteen warps of a hundred fathoms each, which, if the descent be perpendicular, is just equal to 8400 feet. However, it is probable that this course is usually at an inclination of between seventy and eighty degrees from a vertical line, but arriving nevertheless, at depths much beyond ordinary soundings. Supposing the eye of the whale exposes to the water six square inches in its entire superficies, when the monster dives to the depth to which it has been assumed that he has the power of going, the hydrostatic pressure on the eye will be equal to 23,100 pounds. Six square inches are the twenty-fourth part of a square foot; and at 8400 feet, the weight being 554,400 pounds, it follows, therefore, that the eye resists the force or pressure of just 23,100 pounds.

When a tightly corked bottle is sunk one hundred fathoms, at sea, the cork has invariably been forced in, and the bottle found full of water, when brought to the surface. If the cork be capped wtih sealing wax, on coming up it will be inverted, the sealed end being downward. On the other hand, if nothing is applied, then the cork will generally have a horizontal position. These experiments, however, have been so frequently made, that they have ceased to be interesting to philosophers.—[Ibid.]

[From the London Mechanics' Magazine.]

STEREOTYPE SUBSTITUTES.

Sir,—A writer in your Monthly Part for January, alludes to the probability of an invention by which the letters may be transferred from printed books to a kind of stereotype plates, by which copies may be infinitely multiplied, without a new composition or re-setting of types. Chemistry will no doubt add this to the numerous obligations it has already conferred upon the world; and the printing once transferred, the Chinese, or indeed the lithographic printing, may satisfy us, that the letters will be sufficiently in *relief.* The letter of your correspondent has suggested to me a question, whether lithography does not already supply us with a cheap mode of preserving a fac-simile copy of any types which have once appeared in the page of the printing compositor? What objection would there be to keep a copy of any printed page on transfer paper? Letter-press printing has long been successfully transferred to the lithographic stone, and if the copy taken off on transfer paper would keep for any length of time, we might, at very trifling expense, produce a few copies of a work, whenever they were wanted. I hope some of your scientific readers, who have made chemistry their study, will be so obliging as to solve this question: whether a copy made on transfer paper will keep for any length of time without being decomposed? In many cases the benefit to the literary world would be very great, from having the means of keeping (and renewing) a copy of a printed page, for immediate use, as type, in a space scarcely greater than

that occupied by a printed book, and from it to have the power of producing copies, at an expense not worth any consideration, when compared with the cost of re-setting the press. I am, &c. B. S.

Effects of Lightning.—The Boston Traveller says: Our readers will be interested in the following account of a scientific examination of the several buildings in this vicinity, injured by lightning during the storm of the 13th ult. It is from the pen of a practical electrician, well known in this community, who has been eminently successful in his researches, and who seems at length to have perfected the application of metallic rods to the prevention of dwellings from damage by lightning. It is certainly very remarkable, as mentioned below, that of four buildings struck, three should have been furnished with the round rod so common in most parts of the country.

"Sir—By request of a number of scientific gentlemen, I proceeded in company with one of them to examine the buildings struck by lightning in this vicinity, on the afternoon of Saturday, June 13. The first was the dwelling house of Professor Palfrey, at Cambridge. The Professor politely accompanied us, and gave all the information required. This building had a round lightning-rod, with points at the top, but blunt in the ground. It was affixed to the back part of the building. In this examination, I was satisfied that the discharge of lightning was horizontal, from one cloud to another, taking the earth in its course. Passing over the points of the rod, it was attracted by them, passed down the rod to the upper part of the lower story; here it left, and struck into the building, passing through various parts and rooms by the bell wires, which were melted and otherwise destroyed. It left the house by the front door. In one remarkable instance, the lightning passed by the side of a door on a bell wire, which it melted, spreading the oxide of the wire on the plastering in its passage.

"From this building we proceeded to Brighton, and examined the meeting-house of the Rev. Mr. Austin. Here I was again satisfied that the discharge of lightning was horizontal; being received on the points of the round rod, it passed down the rod to the side of the building opposite the stove funnel, when it struck into the building, taking the stove funnel in its course, and passed down on one of the supporting pillars of the gallery, and off to the ground on one of the beams that supported the floor.

"Some days after, I visited the meeting-house near the bridge in Braintree, which was struck by lightning during the same storm. This house had also a round rod, pointed at the top and blunt in the ground. Such rods afford but an imperfect protection. In this instance, the earth about the conductor was considerably disturbed. About ten feet from the ground, near the rod, there was a perforation in the side of the building, where the lightning entered and passed under the stairway that leads to the gallery, and through the partition to an iron brace that supported the stove funnel. It then appears to have passed on the funnel to another brace, that was secured to one of the pillars, on which it descended, shattering it to pieces. The pillar opposite was also a little damaged; and other trifling injuries appeared about the building.

"I have also examined a dwelling house at Brookline, that was considerably damaged by lightning at the same time. This house had no conductor. The lightning struck a large tree in front of it, which it evidently left and descended on the building.

"During this thunder storm, we have three instances out of four, where houses having round conductors were struck by lightning, and where, it is evident, the rods afforded but little or no protection. The cause to me is very plain. In the first place, the number of rods is not sufficient. Secondly, they do not present in all directions a sufficient attracting power; and thirdly, they are in most cases put upon buildings by persons who are not familiar with the science of Electricity and the operations of lightning; and who of course are liable to leave them faulty in many very essential particulars.

"During thunder storms, there are three different discharges of lightning—from the earth to the clouds—from the clouds to the earth,—and through the atmosphere from one cloud to another. These latter discharges are more frequent than any other, and often take the earth

in their course, and were by the philosophers of the last century called rebounding strokes of lightning. To meet these various discharges of lightning, we must have conductors armed at all parts—that is, they should present in all directions an attracting influence, by which the electric fluid may be discharged gradually and silently, without an explosion. The explosion prevented, all harm is prevented. This attracting, or receiving power, as it is more properly termed, depends on the points; hence the greater the number of points and sharp and rough corners, the greater the protecting power. Conductors should not only be armed with these numerous points, and should be pointed on the ground, but they should be placed upon the most exposed parts of the building. This requires the judgment of a person acquainted with the operations of lightning, and the nature of different substances to conduct it. Let such rods be placed on our buildings, under the direction of an experienced electrician, and we shall no more hear of lightning leaving the rod and striking into the building.

"Certain trifling things have been considered necessary for lightning conductors; such as silvering the points—pieces of glass to prevent the lightning from entering the building—and surrounding the lower extremity of the rod with charcoal. These are of no use whatever. That round rods with their silver points, their glass fastenings, and the lower end surrounded with charcoal, do not afford sufficient protection, is evident from the fact, that a great proportion of the houses struck by lightning are houses professedly protected by such rods. That the square rod with the numerous points and sharp corners does most effectually protect a building, may be easily proved by experiments with an electrical machine, to the satisfaction of every unprejudiced person. Another consideration of some importance in favor of these rods, is the fact, that of more than two thousand houses thus protected, I have never known an instance where the building was in the least injured. These rods discharge the electric fluid without an explosion, and consequently without harm."

How to insure Success.—**The surest way not to fail is to determine to succeed.—[Sheridan.]**

Experiments on the Transverse Strength and other Properties of Malleable Iron, with Reference to its Uses for Railway Bars. By Peter Barlow, F. R. S., Cor. Mem. Inst. of France; of the Imp. and Roy. Acad. of Petersburgh and Brussels, etc.

In order to render some remarks and observations in the following pages intelligible to the general reader, it will be necessary to state a few particulars relative to the circumstances which gave rise to the experiments, and to the appearance of them in their present form.

The Board of Directors of the London and Birmingham Railway Company, desirous of carrying on the great work in which they are engaged on the most scientific principles; and, if possible, to avoid the enormous cost of repairs which has attended some large works of a similar description, offered, by public advertisement, a prize of one hundred guineas "*for the* most improved construction of railway bars, chairs, and pedestals, and for the best manner of affixing and connecting the rail, chair, and block, to each other, so as to avoid the defects which are felt more or less on all railways hitherto constructed;" stating, that their object was to obtain, with reference to the great momentum of the masses to be moved by locomotive steam engines on the railway,

1. "The strongest and most economical form of rail.

2. "The best construction of chair.

3. "The best mode of connecting the rail and chair; and also the latter to the stone blocks or wooden sleepers. And that the railway bars were not to weigh less than fifty pounds per single lineal yard."

In consequence of this advertisement, a number of plans, models, and descriptions, were deposited with the company within the time limited by the advertisement; and others were received afterwards, which, although not entitled to the prize, were still eligible to be considered with reference to their adoption for trial. On the 24th of December last, a resolution was passed at a meeting of the Directors, appointing J. U. Rastrick, Esq., of Birmingham, N. Wood, Esq., of Newcastle, Civil Engineers, and myself, to examine and report upon the same, with a view to awarding the prize; and, at the same time, we were requested to recommend to the Directors such plans, whether entitled to the prize or not, as might be considered deserving of a trial. We met accordingly in London; and, after a long and careful examination of the several plans, drawings, and written descriptions, recommended those we thought entitled to the prize, which was awarded by

the Directors accordingly. But that part of our instructions which required us to recommend one or more rails for trial, we were unable to fulfil to our satisfaction, principally for want of data to determine which of the proposed rails would be strongest and stiffest under the passing load, and whether permanently fixing the rail to the chair, for which there were several plans, would be safe in practice. No experiments on malleable iron having ever been made bearing on these points, it was considered better to leave the question unanswered, than to recommend, on no better ground than mere opinion, an expensive trial, which might ultimately prove a failure.

Seeing, however, how desirable it was that such data should be obtained, I proposed to the Directors to undertake a course of experiments, which should be conducted on a scale adequate to the importance of the subject, provided my Lords Commissioners of the Admiralty would allow me the conveniences His Majesty's Dockyard at Woolwich afforded, (which I had every reason to hope they would do, from the liberality I had so frequently experienced from that Board on similar occasions,) and that the Directors would supply such instruments, materials and workmanship, as might be required for the purpose.

The Admiralty, as I had anticipated, immediately granted my request; and at a public meeting of the proprietors, held at Birmingham, a resolution was passed embodying my proposition. I accordingly commenced, and continued my experiments, till I had elicited such facts as I thought necessary; and having arranged them, as in the following pages, I delivered the results, with a report founded upon them, to the Secretary of the London Committee, to lay them before the Board; which being done, the Directors were pleased to express their high approbation of my labors, and their wish that the results should be made public. I have been, therefore, induced to print them in their present form, introducing only such foot notes as seemed to me necessary to render the subject intelligible to the general reader. I have given, also, in addition, the solution of one or two equations, which, to avoid embarrassing the report, had been suppressed, the results only having been stated.

Such are the circumstances under which the following pages have been submitted to the press; and they will serve to account for the form in which the subjects are arranged, which would probably have been different, if the publication in a separate work had been anticipated in the beginning. I have no doubt, however, if the facts elicited be found useful, the form and arrangement will be considered matters of secondary consideration.

PRELIMINARY REMARKS.

It is only since the very general adoption of railways in this country, that malleable iron has been employed to any extent to resist a transverse strain, and writers who have undertaken experiments to investigate the strength of materials, have hitherto passed over those inquiries which relate to the transverse strength of this metal.* The extraordinary extent, however, to which malleable iron is now applied to resist transversely a passing load, renders it highly essential that this resistance, and its other properties, should be fully investigated; for it is obvious, that every additional weight of metal, beyond that which is requisite for perfect safety, is not only uselessly, but injuriously employed, it being generally admitted that bars beyond a certain weight cannot be so well manufactured as those of less dimensions; and it is no less certain, that by a proper disposition of the metal in the sectional area of the bar, (which depends on the data in question,) a greater strength may be obtained with a given weight of iron, than with a greater weight injudiciously disposed. Under these impressions, the following experiments have been undertaken, and to these inquiries only they have been directed; and I am not without hope that on those points they may be found useful.

Before, however, proceeding to these experimental researches, there is one subject, rather of investigation than of experiment, on which I have thought it necessary to bestow some attention, it being one on which the opinions of practical men are much divided; this is, the comparative advantages and disadvantages of what is called the fish-bellied rail, and that with parallel edges.

Examination of the Properties, Curvature, and Resistance, of the Fish-bellied Rail.

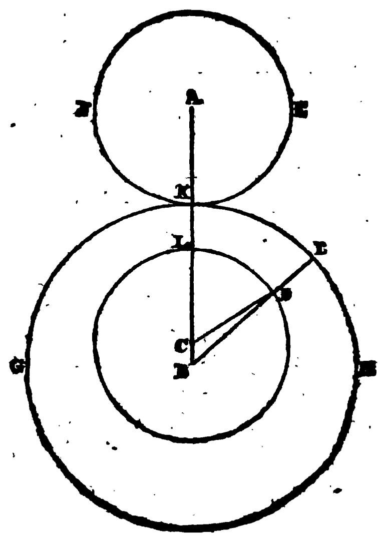
It is well known, both as a theoretical and mechanical fact, that if a beam be fixed with one end in a wall, or other immovable mass, to bear a weight suspended at the

* Some few experiments on the transverse strength of malleable iron have certainly been made. I have given three in my Essay on the Strength of Materials. Mr. Hodgkinson has also glanced at this subject in his valuable paper of Experiments on Cast Iron, published in the Memoirs of the Manchester Philosophical Society, and M. Duleau has treated of the subject in his "Essai Theorique et Experimental," &c.: but those points of greatest importance connected with the application of this metal to the purposes of Railways have never formed the subject of inquiry.

other end, the longitudinal section of such a bar (its breadth being uniform) should be a parabola; because, with that figure, every part of it will be strong in proportion to its strain, and thus one-third of the material may be saved. This form of construction is frequently adopted in the case of cast-iron beams in buildings, and with great advantage, as thereby one-third of the material is saved, while the strength is preserved, and the walls of the building relieved from a great unnecessary weight.

This seems to have led to a somewhat similar principle of construction in what is called the fish-bellied rail; and the question here is, with what advantage? In the first place, it is to be remarked that the figure, which theory requires in this case, is not, as in the preceding, a parabola; for, as in the transit of the locomotive, every part of the bar has, in succession, to bear the weight; and as the strain on any part of a beam supported at each end, and loaded in any part of its length, is as the rectangle of the two parts,—the strength being as the square of the depth,—it follows that the square of the depth ought to be every where proportional to the rectangle of the two parts, which is the known property of a semi-ellipse. The bar, therefore, in theory, ought to be a semi-ellipse, having its length equal to the transverse diameter, and the depth of the beam for its semi-conjugate, and there can be no doubt, that such a figure would be, to all intents and purposes, as strong in its ultimate resistance as a rectangular beam.

But it is difficult to obtain this figure correctly in malleable iron, and many of what are called fish-bellied rails are but bad approximations to it, although others differ from it but slightly. The following is the general mode of manufacture. [See figure.]



EF is the section of an iron roll; GH the section of another. This latter being hung on a false centre C, is turned down, leaving a groove of varying depth as shown in the figure. The cylinder GH being now again placed on its proper centre B, the bars are introduced between the two rolls at KL; and as the iron passes through, it acquires the variable depth shown in the lower roll. The inner circle, or bottom of the groove, is generally one foot in diameter, and the upper three feet in circumference; consequently, the figure is completed in a length of three feet, and there are commonly five such lengths in a bar. The computation of the ordinates to the curve thus formed is by no means difficult; for, calling the radius of the cylinder CD=r, and the distance of the centres BC=d and x any angle LCD, we find the ordinate,

$$ID=BI-\sqrt{(r^2+d^2-2rd\cos. x.)}$$

And by this formula the ordinates of the curves have been computed for two different fish-bellied rails; the extreme depth in both being five inches, but the lesser depth in one three inches, and in the other three and three-quarter inches, the latter being that proposed by Mr. Stephenson for the London and Birmingham Railway. The ordinates are taken for each 10°, or for every inch of the half-length, and in the last column are given the ordinates of the true ellipse.

TABLE OF ORDINATES.

Abscisses.			Ordinates in Fish-bellied Rail. Greatest depth 5 in. Least do. 3"	Ordinates in Mr. Stephenson's Rail.	Ordinates in the Ellipse.
Deg.		In.			
0	=	0	3·00	3·75	0
10	or	1	3·01	3·76	1·64
20	··	2	3·05	3·78	2·29
30	··	3	3·12	3·82	2·76
40	··	4	3·21	3·88	3·14
50	··	5	3·31	3·95	3·46
60	··	6	3·44	4·04	3·72
70	··	7	3·59	4·14	3·96
80	··	8	3·75	4·23	4·16
90	··	9	3·92	4·34	4·33
100	··	10	4·09	4·45	4·48
110	··	11	4·27	4·55	4·61
120	··	12	4·43	4·66	4·71
130	··	13	4·59	4·75	4·80
140	··	14	4·72	4·84	4·87
150	··	15	4·84	4·91	4·93
160	··	16	4·93	4·95	4·97
170	··	17	4·98	4·99	4·99
180	··	18	5·00	5·00	5·00

We see by this table, (although it is impossible, with any proportions or degrees of eccentricity, to work out a true ellipse by this method,) that we may approximate towards it sufficiently near for practical purposes, as Mr. Stephenson has done; while, on the other hand, without due precaution, we may so far deviate from it as to render the bar dangerously weak in the middle of its half-length.

As far as relates to ultimate strength, there can be no doubt Mr. Stephenson's rail is equal to that of an elliptic rail, and consequently to that of a rectangular rail of the same depth; but there is still an important defect in all elliptical bars, viz., that although this form gives a uniform strength throughout, it is by no means so stiff as a rectangular bar of a uniform depth, equal to that of the middle of the curved bar, and it is the stiffness rather than the strength that is of importance; for the dimensions of the rail must so far exceed those which are barely *strong enough*, as to put the consideration of ultimate strength quite out of the question. The object, therefore, with a given quantity of metal, is to obtain the form least affected by deflection; and unfortunately the elliptical bar, although equally as strong as the rectangular bar of the same depth, as far as regards its ultimate resistance, is much less stiff. This will appear from the following investigation.

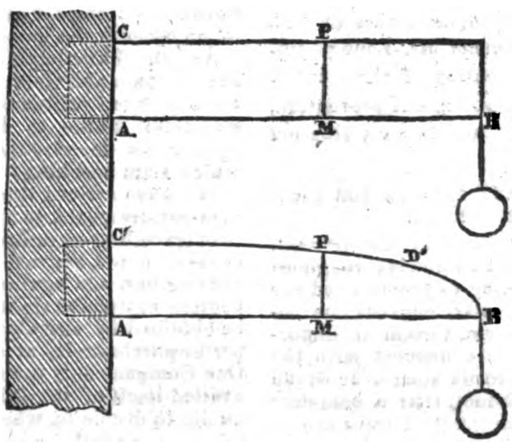


Fig. 1.

Fig. 2.

The deflections which beams sustain when supported at the ends and loaded in the middle, is the same, as the ends would be deflected, if the beams were sustained in the middle, and equally loaded at the ends, each with half the weight; and the *law* of deflection is the same in the latter case, as when the beam is fixed in a wall and loaded at its end, although the *amount* is greater. At present, however, our inquiry is not the actual, but the relative deflection in two beams, one elliptical, and the other rectangular, of the same length, and of the same extreme depth—the breadth and load being also equal in each. It is quite sufficient, therefore, to consider the corresponding effects on two half-beams, each fixed in an immovable mass, as representes in the preceding figures.

Now, in the first place, the elementary deflection at C is the same in both beams, because the lengths and loads are the same, and the depths at C A equal; but the whole deflection at any other point P, will be directly as M B², and inversely as M P³. If, therefore, we call M B$=x$, and M P$=y$, the sum of all the deflections in the two beams will be $\int \frac{x^2}{y^3}.\ d\ x\ \triangle$, $\triangle$ being the sine of deflection at C. But in fig. 1, y is constant and equal to d, (the depth,) while in the latter,

$$y=\frac{d}{l}\surd\ (2\ l\,x-x^2)$$

l being the semi-transverse or length, and x any variable distance.

The whole deflections, therefore, in the two cases, are,

Fig. 1:—

$$\text{Deflection} = \frac{x^2\ d\,x}{d^3}\triangle = (\text{when } x=l)$$

$$\frac{1}{3}\frac{l^3}{d^3}\triangle$$

And in fig. 2:—

$$\text{Deflection} = \int \frac{x^2\ dx\ \triangle}{\frac{d^3}{l^3}(2\ lx-x^2)^{\frac{3}{2}}} = (\text{when } x=l)$$

$$\cdot 41\ \frac{l^3}{d^3}\triangle$$

The deflections, therefore, in the two cases are, with the same weights, as 33 to 41,* or nearly as 3 to 4, a result fully borne out by subsequent experiment. It is to be observed, also, that this investigation applies only to the deflection when the weight is in the middle of the bar, and that it would be much greater in comparison with the parallel rail towards the middle of its half-length. (*To be continued.*)

The following notice, from the U. States (Phila.) Gazette, of Mr. Young's apparatus for preventing fire from locomotive engines, is well worthy of attention. It is very important that measures should be adopted on *all* railroads to prevent accidents by fire. We earnestly recommend Mr. Young's improvement to the attention of those interested in railroads—"an *ounce* of prevention, &c." Every person understands this old adage.

YOUNG'S PATENT SPARK CATCHER FOR LOCOMOTIVE ENGINES.

Mr. Editor: At a time like the present, when the extension of railroads throughout our country is becoming so general, and the employment of locomotive engines has become a matter of course, I deem it important that all persons connected with the management of railroads should be made acquainted with the fact, that a complete remedy exists for the greatest nuisance to which this mode of travelling is liable, viz: the emission of sparks from the engine. That remedy is to be found in the contrivance with the name of which this article is headed, and the patentee is prepared to dispose of the right of using it, either at a reasonable rate for each engine, or at a gross sum, to be paid for the privilege by each company that may be desirous of availing itself of his invention.

It is now upwards of two years since the Spark Catcher of Mr. Young† has been in use on the New-Castle and Frenchtown railroad, since which period no instance has occurred on that road of a single garment having had a hole burnt in it by a spark from a locomotive engine. Of the tens of thousands of persons who have travelled the New-Castle road during the period named, not one can be found to gainsay the above statement.

Is there a single person, who has travelled on any other road in the United States, on which locomotives are used, with wood for fuel, that has not been annoyed, and either had his flesh or clothing burnt during his journey, by the means I have mentioned? I do not believe there is one to be found.

Is the Camden and Amboy road free from the intolerable and dangerous annoyance? No!—Baggage cars have been burnt, passenger cars have been on fire, and ladies almost denuded.

Is the great thoroughfare of Pennsylvania, the Columbia railroad, free from it? No! Barns, wood, crops of grain, and fences, have fallen beneath the flames in turn.

Are the Philadelphia and Trenton, the Philadelphia and Germantown,—in a word, are any of our railroads in the whole country, from Maine to Louisiana, provided against the inconvenience and danger of which I am speaking? No! not one.

We have arrived then at this point; the greatest drawback to the pleasure and safety of travelling on railroads with locomotive engines, is fire emitted from the chimnies of the engines, and against this a perfect preventive exists, the right to use which may be obtained by any Company that see proper to purchase it, at a reasonable price. One Company only in the United States has availed itself of it. The question for the public to decide is, whether they will suffer this sort of carelessness or false economy to prevail in Railroad Boards any longer, and allow their own property and lives, and those of their wives and children, to be jeopárded, or whether they will resolve with one accord to prosecute in all cases of damage the Company that undertakes to convey them safely without taking the proper precautions to do so.

The writer of this article is as ardently attached to the railroad system as any man in the country. He has long looked on the monstrous abuse, he is now noticing, in silence, but a solemn sense of duty, quickened by a recent signal illustration of the danger to which life is subjected by neglect in guarding against the particular evil of fire, has at length urged him to break his silence.

And I hope that this brief notice may induce a general attention to the subject, which is one, in my humble judgment, of paramount importance both to the corporations alluded to, and the public.

One word more. The assertion is distinctly made, and all contradiction of it defied, that Young's Spark Catchers are a perfect preventive to the emission of sparks

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* Experiments have been made from which it has appeared that the fish-bellied rail was stiffer than the parallel rail, which is certainly possible, if the parallel rail be of inferior metal or of injudicious figure; but it is mechanically impossible if the parallel bar be made of the figure here assumed.

† Mr. Young is the Engineer of locomotive power on the New-Castle and Frenchtown road, and resides at New-Castle.

from the chimnies of locomotive engines when in use. I believe it might be asserted with equal safety, that no other contrivance has been found to answer at all. L.

June 16th.

[From the Edinburgh Quart'y Journal of Agriculture.]

On an Improved Method of Mounting the Cradle-Scythe.—So far as I recollect, the Rev. Mr. Farquharson, of Alford, stated, in his former communication to the Highland Society on scythe-reaping, that latterly no appendage whatever was used on the scythe, in his neighborhood, for assisting in carrying round the cut corn to the swathe; and that scythe-reaping had been brought to its present pitch of perfection by laying all that sort of thing aside, and using nothing but the common hay scythe. In his last paper, however, he seems to admit the necessity of using a bow, except when the crop is much lodged; but even in that case I am clearly of opinion that some appendage on the scythe is indispensably necessary, and certainly would prefer a small rake to any thing I have yet seen. I have now had another year's experience of the cradle-scythe,* and have no hesitation in saying that it is the most efficient implement of the kind that I know of. Its superiority to the "long curved handle" consists, as I formerly stated, in the comparative ease with which it is wrought, which every person who has used it, and with whom I have talked on the subject, readily admits. I do not say that an experienced mower will not make sufficiently good work with a scythe fixed to the long curved handle, provided a rake be attached to it; but let any one compare such and the cradle-scythe at work together, and he will be at no loss to discover the preferable implement. Before the introduction of the cradle-scythe, the scytheman used to complain a good deal, for some days at the commencement of harvest, of *sore sides;* but no such complaints are now heard of. This is easily accounted for: Before the cut corn can be laid nearly square to the uncut with the long curved or common handle, the mower's left hand requires to go at every sweep considerably farther round to the left than with the cradle-scythe, owing to the position of the handles on the sned; and this, of course, occasions a corresponding turn of his body in that direction, which must be very sensibly felt.

The rake can be made very light; in fact, very little, if any thing, heavier than a bow, and the expense of either is trifling. I find that one bar about ⅜ths of an inch thick quite sufficient to hold the teeth; and for all the cost I would recommend having rakes of various lengths, of from ten to thirteen or fourteen inches. For one of the shortest size, three teeth are commonly used, but I think they are no worse of four; and experience has taught me that much shorter teeth than those generally in use answer equally as well, and are much more easily disentangled of the cut corn. The teeth should be curved a little, like the blade of the scythe. Last harvest, a friend of mine suggested it as an improvement to have rakes of a circular form, and made so as to move out and in on a hinge at the lower end, in order to suit the different inclinations of the crop. Coinciding in his opinion, I got some of them made for a trial, and have the satisfaction to say, answered remarkably well. The head of the rake is eleven inches in length, and is curved to form a segment of a circle of about one foot four inches radius. The uppermost teeth are from five and a half to six inches long, and each of the three lowermost extends an inch beyond the one immediately above it. Instead of the rake being fastened to the heel of the scythe, as mentioned in my last letter, a piece of iron with two upright plates is clinked to the back of the scythe, about an inch from the back end of the blade. The rake is inserted between these upright plates, as in a socket, and a round nail with screw and nut is passed through them to keep the rake in its socket. By this contrivance, the rake can move backwards or forwards on the round nail as occasion requires. It is held steady, in whatever position it is placed, as follows: The small iron rod that connects it with the left handle of the frame is made thin at the end, and has seven or eight holes in it about ⅜ths of an inch asunder. This part of it is bent so as to correspond with the limb or plane of the handle, to which it is held fast with a nail and thumb-screw, and by which it is readily shifted. The nail is put through the handle, from the lower side, six inches above where the handles unite. When

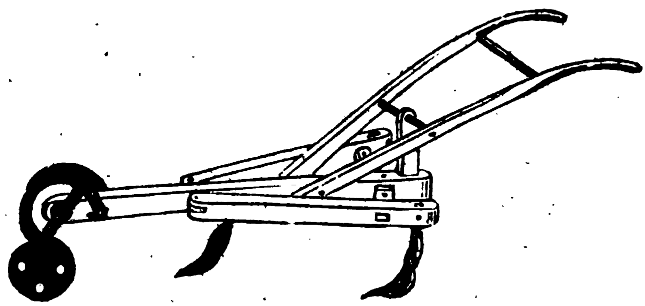
* Cradle, a frame for a scythe.—[Bailey's Diction'y.]

the corn stands upright, there is no difference in the position of the rake to the blade and handle of the scythe from the straight rake, except that the former is placed on the back edge of the blade, and the latter fixed into an eye-headed wedge at the heel of it. Both stand perpendicular to the blade, and it is only when the corn lies away from the scythe that the position of the circular rake differs from that of the other. If the corn be lodged or partly laid over with wind at the time of mowing, the circular rake is set back at the top by shifting the holes in the end of the rod that holds it fast to the handle, so as to answer the lay of the corn; and it is in this respect that it has the advantage of the straight-headed rake.

Last year, part of my crop, both oats and barley, was a good deal lodged; indeed, some of the former, on soft mossy land, were laid flat and twisted in every direction. The operation of cutting was consequently more tedious; but all was performed with the scythe in good style, and at much less expense than it could otherwise have been done. In instances of this kind, I would humbly recommend to cut *in* instead of *out* of corn, as it is usually termed. I adopted this plan last season, and really think it a good one. At first the scythemen were averse to it, but in less than half a day they changed their opinion, and acknowledged it to be the best. I commenced with it in a field of pretty ripe potato oats, which were a good deal lodged, and the grain dropping off in the working; and it was soon discovered that there was less loss of grain, a much freer cut, fewer rakings, and a neater stubble,—circumstances of no small moment to the farmer. The corn can be laid round, as even, and nearly as square, the one way as the other; but cutting *in*, if the crop is thick, seems rather hardest for the uptaker, which is owing, in some measure, to the free working of the scythe on the right hand, which allows the operator to come more speed.

Now that that very important operation, scythe-reaping, has become common in many parts of the country, and is practised in various ways in different places, it occurs to me that it would be an object well worth the serious consideration of our agricultural societies to promote its improvement, by holding competitions, and awarding prizes to the most meritorious competitors, as in the case of ploughing matches.

I. F.



Bement's Improved, Triangular, Expanding Cultivator, or Horse Hoe. [Communicated for the New-York Farmer, and American Gardener's Magazine.]

The above drawing is taken from one made for Mr. Bement's own use, with only three shares or teeth, and made very light, to be drawn by a small pony. The usual size has three shares and two scarifiers. The shares are double pointed, having one point at the top and another at the bottom, and are attached to the stock by a small screw-bolt and nut in the middle, so that when one point breaks, or is worn out, by turning the other end down, a new point or share is presented. A larger or smaller share may also be attached to the stock as occasion may require. The shares may also be replaced by scarifiers.

By the peculiar construction of the clevis, the roller or wheel, and with it the beam, can be regulated to any height required; and by raising or towing the hook, the line of draught can be adjusted accordingly. The sides may also be set wider or narrower, to suit any occasion.

In putting in such grains as are proper to be ploughed in, as barley, oats and peas, the larger shares may be used. The shares can be replaced by scarifiers, which are useful for cleaning out quack and other troublesome weeds, as well as scarifying meadows, previous to a top dressing of manure.

This cultivator or horse hoe is, in proportion to its cost, perhaps as valuable an implement as can be had on a farm, serving, as it does, a variety of uses, and being in all cases light and convenient to use; and I should think by the number of orders Mr. B. is receiving, it is coming rapidly as well as deservedly into use.

Fair of the Mechanics' Institute of the City of New-York. — The following circular is cheerfully published with a view of calling attention to the subject.

Institute Rooms, City Hall,
New-York, July 1, 1835.

This institution was founded in 1830, and incorporated by an act of the Legislature, in 1833, and now enumerates about seven hundred members; and has for its object, the instruction of mechanics and others in all the useful branches of science and the arts, while the tenor and spirit of its construction prohibits the introduction of politics, religion, or irreligion.

The course of education in our common schools, which the young mechanic generally leaves for the workshop, enables him to acquire a knowledge of reading, writing, and the rules of common arithmetic: but beyond these branches it scarcely makes any pretensions: he therefore labors under a serious difficulty at the very commencement of his business, namely, that of being compelled to learn a set of dry and often uninteresting rules, without a previous acquaintance with the principles upon which they are founded. It was with the view of supplying this deficiency, as well as others hereafter to be mentioned, that the 'Mechanics' Institute of the City of New-York' was established. It was designed as a school for teaching the most useful branches of physical and chemical science, to prepare the mechanic to understand and appreciate the lectures of the college or university, and thus increase his knowledge, usefulness, and happiness. The institution is founded on the most liberal principles, and though intended especially for mechanics, is open to all who are disposed to avail themselves of its privileges. An initiation fee of two dollars and the same amount in annual dues secure admission to its lectures, and exhibitions, and also to the use of the library.

In accomplishing its designs, the Institute has established regular annual courses of lectures on a variety of subjects connected with improvements in the arts, but more especially on chemical and mechanical philosophy. It has also an excellent library, a reading room, museum of models, and a valuable collection of chemical and philosophical apparatus — all of which are appropriated for the benefit of its members. To increase still more the facilities for the acquisition of useful knowledge, the Institute has engaged a scientific gentleman, who, under the supervision of the Board of Directors, has charge of the entire property, and gives his personal attendance at the rooms, which are now kept open day and evening throughout the year.

The Institute Rooms, situated in the City Hall, and consisting of a lecture room, reading room, library, museum of models, apparatus, etc., are now opened daily for the uses of the members and for the inspection of the public, where all who feel an interest in the advancement of science and improvement in the arts, are most cordially invited to call and obtain for themselves more perfect information as to the character, objects, and history of this institution.

To extend still farther its usefulness, and to carry more fully into effect its designs, the Institute has come to the determination to establish an *Annual Fair*, where the results of the genius and industry of the mechanic can find a ready avenue to the public eye, and thus be known and appreciated.

It is not intended that the Fair shall be confined to the productions of our own city; but, on the contrary, it is hoped that its managers may have the gratification of enumerating amongst the articles for exhibition, the productions of mechanical genius from every city and town of the Union.

Under these considerations, the Managers appeal with confidence to the public, and particularly to all immediately interested in the improvement and perfecting of the mechanic arts, to support them in their praiseworthy object—the moral and intellectual elevation of the mechanic, both in his own estimation and in that of others.

It may be further stated, that the Fair will be solely conducted by mechanics, for their improvement and benefit; and that the funds arising from the proceeds will be appropriated for the advancement of the objects of the Institute; it relies, therefore, with the utmost confidence on a liberal patronage from the public generally, and more especially from mechanics.

The Fair will be opened on Tuesday morning, the 29th of September next, at Castle Garden, where all articles for exhibition must be brought on the day previous.

For more detailed information, address the Corresponding Secretary of the Mechanics' Institute, City Hall, New-York.

A circular to the mechanics will soon be issued, containing an account of the premiums to be awarded, and the regulations by which the Fair will be governed.

Committee of Arrangements:

Samuel Carter, John Bell, William Ballard, Jonas Humbert, Jr., Henry Durell, John W. Dodd, N. S. Hunt, George Bruce, John Thomes, William Stebbins, Peter Walters, Uzziah Wenman, L. D. Gale, S. S. Ward, William Belcher, William Partridge, Oliver White, G. L. Price, Sereno Newton, Thomas Godwin, J. S. Redfield, W. H. Hale, James Walters, Gabriel Furman, John N. Baur, Daniel A. Robertson, Henry Cunningham, Thomas Timpson, John Steele, Jr., Henry Ludwig, James McBeath, John Remick, G. D. Kashow, George Sullivan, Charles Belcher, John Wint, P. C. Cortelyou, Colin Lightbody, William Norris, Fitch Taylor, Adam Hall, Robert Smith, William Everdell, Alex. Masterton, L. D. Chapin, William Frisby, Walter L. DeGraw, L. Feuchtwanger, Augustus Campbell, Samuel Bailey.

Samuel Carter, Chairman.
L. D. Gale, Secretary.

By order of the Institute:

George Bruce, President.
Henry Cunningham, Secretary.

We have been furnished with the following circular, giving notice of the 'Eighth Anniversary Fair of the American Institute of the City of New-York;' which will, we doubt not, as heretofore, be well attended, and at which our citizens will as usual derive much pleasure.

The Managers have the satisfaction to state, that they have procured for the coming Fair, Niblo's spacious and convenient establishment, 576 Broadway.

Articles intended for competition for premiums, will be received at the Garden on Friday and Saturday, the 16th and 17th of October next.

On Monday forenoon, the 19th of October, the judges will examine the articles intended for premiums. Such as are for exhibition merely, may be brought at any time during the Fair.

On Monday, at 12 o'clock, the Garden and the Saloon will be opened to visiters, and continue open four days.

The preparations for this exhibition already brought to the knowledge of the Managers, satisfy them that the coming Anniversary will afford the most cheering proof of our rapid progress in the arts, by a more ample display of the extent and perfection of American skill and industry, than has ever before been exhibited in this city; as well in the household departments of industry, as in those of the workshops and the larger manufactories.

The objects of the American Institute, under its charter, are broad and multifarious, embracing agriculture, commerce, manufactures, and the arts, throughout the United States. Space has accordingly been provided, suitable for a great number of bulky productions, natural and artificial.

The exhausting effects of our importations of woollens, cottons, and silks, amounting to nearly thirty millions of dollars per annum, render their increased home production extremely desirable. With a view to this, the quantity of broad-cloths presented for competition for the first premium, will be required to be not less than fifty yards; and cassimeres not less than one hundred yards. And in the awarding of premiums on cotton and silk goods, some regard will also be had to the quantity.

Inventors of curious and useful machines are particularly invited to exhibit their operations. These moving evidences of mechanical genius impart life and entertainment to the scenes.

The Ladies at all our former Fairs have contributed largely to render interesting the display. The Managers rely in full confidence on their continued favors.

Patriotic individuals—friends of American industry, and distinguished characters in this and other states, — are invited to attend the exhibition, and give their accustomed countenance and support to an institution that has for so many years exerted its influence to stimulate industry, and establish on a durable basis the independence of our country.

Thaddeus B. Wakeman,
Martin E. Thompson,
Adoniram Chandler,
Jonathan Amory,
Andrew Williams,
James F. Kenny,
Joseph Torrey,
John Sampson,
Frederick H. Wolcott,
Joseph Titcomb,
Charles H. Hall,
Isaac Fryer,
Edward V. Price,
Managers.

[From Transactions of the Essex Agricultural Society.]

ON COLORING.

[Continued from page 21.]

Black.—To dye woollen goods black, perfectly and most durably black, they must first receive an indigo blue, as described in our first method, and be well scoured out afterwards. The mordant used in dying black is iron—sulphate of iron (copperas) is most generally used for wool. There are a great number of dye-stuffs, both native and imported, used in coloring black. Nutgalls are usually considered the best for this purpose, but Bancroft says, and we think correctly, that the bark of the red flowering maple (acer rubrum), so common in swamps in this county, gives "a more intense, pure, and perfect black, than even galls, or any other vegetable matter within our knowledge." Logwood is a useful addition, especially where the cloth has not received an indigo blue. It certainly improves the appearance of the black dye from galls and iron, by rendering it more intense, glossy, and soft. In fact, it seems that almost every coloring vegetable matter for which the fibres of wool have an affinity, adds something to the body of black, and lessens the hardness or harshness which iron gives to wool. Among other articles, therefore, which may be advantageously used in black dyes, are the barks of our common elm and alder, and several species of lichen, or mosses, which grow on rocks, and have long been in use among us for dyeing various cheap colors.

For best Black, on cloth previously colored blue with indigo, take dried maple bark 12 ounces, or 1 lb. of the fresh undried bark, logwood 6 ounces, elm bark 8 ounces, and boil them in two gallons of water for one hour. Take out the bark, immerse the cloth, and boil another hour. Then take 5 ounces of copperas, dissolve in 2 qts. of water, and add it slowly to the liquor in the boiler. The cloth should be kept continually turning in the boiling liquor for two hours. Take it out, cool it, and again soak it in boiling water, to which a small quantity of ox gall or fresh cow dung has been added, another hour. Rinse it out, and scour it well with hot water and hard soap.

Cloths not colored with indigo will take a good black if the quantity of logwood be increased, and the dippings alternately in the decoction of the bark, &c. be many times repeated.

Black on Silk.—The fibres of silk do not so readily receive the black dye as those of wool. What the woollen dyer effects by three or four dippings, the silk dyer scarcely obtains from twenty. As the affinity of the silk for the soluble part of the galls or maple bark is greater than with the iron, it is thought most advantageous to begin by boiling about one half as much in weight of the galls or bark as of the silk to be dyed, in a suitable quantity of water, for three or four hours. Let it settle, pour off the clear liquor, and macerate the silk in the same for twenty-four hours. Being dried and slightly rinsed, the silk is afterwards immersed in a solution of the sulphate of iron (copperas), moderately warmed, and kept therein twelve hours, after which it should be rinsed and immersed in a warm decoction of logwood for several hours, again immersed in the solution of iron, rinsed, again transferred to the decoction of bark, &c.; repeating these alternate immersions till the desired color shall have been produced. Iron, dissolved in vinegar, is still better than copperas. A black vat may be easily prepared for coloring silk, by immersing in vinegar old iron hoops, turnings of iron, or iron in small and thin pieces, to which may be added maple bark, the berries and bark of the sumach, oak bark, alder bark, &c. and left to undergo a gradual solution by the joint action of the acids and acerb vegetable matters. The longer the liquors are kept, the better. In some coloring establishments in Europe such vats have been kept for ages, being replenished from time to time by additions of the several ingredients above mentioned. By repeated dippings in black dyes, silk may be made to acquire nearly a fourth part more in weight than it possessed before its natural gum had been separated from it by the boiling with soap, a process to which all new silk should be subjected before it is colored. But the color produced by this excess of black is not so good as it is when no such excess has been employed. As soon, therefore, as the silk becomes sufficiently colored, judging by the eye, it should be rinsed out and passed through a bath containing at the rate of one pound of starch and half a pound of linseed oil, well mixed with six quarts of warm water.

Black, on Cotton.—Cotton may be colored black in the dyes above mentioned for wool and silk. A somewhat different management is however recommended by the best writers on the subject. One, who is considered good authority, recommends making a decoction by boiling the logwood, maple bark, &c. above directed, and pour the clear liquor into a tub. Fill another tub with a like quantity of lime water, and another with the copperas water, formed by dissolving two and a half ounces of copperas to each gallon of water, and while the decoction and lime water are nearly boiling hot, dip and turn the cloth for thirty minutes, take it out, wring and air it; then put it into the copperas water and turn it as usual

fifteen minutes; wring and air it again, then dip it in the lime water five minutes, and let it be well washed. If the color does not become sufficiently dense, repeat the operations until the desired effect be obtained. Then dip it in the mixture of starch, oil and water, as directed for silk. Much benefit may also be expected from soaking it a short time, previous to its being oiled, in a mixture of ox gall and water. When the cloth has not been first dyed blue with indigo, more dippings and a stronger decoction of logwood will be necessary. In some great dyeing establishments the black vat, as directed above, is chiefly used for coloring cotton black, instead of the copperas water, and is doubtless preferable, when it can be readily obtained. The cloth should be first steeped in a decoction of nutgalls, or the barks above directed, and afterwards macerated and worked several times in the liquor of the black vat, drying it between each of the macerations, and finally, being well rinsed, it is to be dyed with a quantity of maple bark, galls, &c., to saturate the iron imbibed in the black vat. To soften the black so produced, the yarn, &c. is usually passed through a bath of starch and oil, well mixed and stirred, employing for this purpose at the rate of one ounce of oil for each pound of cloth, yarn, &c. This employment of linseed oil gives a soft, glossy appearance to the black dyed upon cotton and linen, renders the color more intense and durable, and is particularly important for sewing thread. But care must be taken not to withdraw the cotton from this mixture till by suitable management the oil has been equally applied to all parts of it.

Having given what we believe some of the best methods of dyeing the four simple colors, and incidentally mentioned some of their compounds, we now proceed to give directions for coloring several of these which are most frequently used, or which have been, or still are, most highly esteemed by mankind. Among these are the purple, once the most costly and valued of colors, worn only by princes and the most wealthy of mankind. The ancient color was produced by a liquor found in small quantities in one or more species of shell fishes. It is yielded by a species of the Buccinum, which resembles in form the garden snail. This liquor is found in a little white or yellowish bag, placed transversely in immediate contact with the shell, near the head of its inhabitant. It is nearly colorless, but when applied to linen, cotton, &c., and exposed to the rays of the sun, it will become green, blue, and finally a most durable purple. Perhaps this animal may be found on our coast, and be advantageously used for marking fancy work, &c. Josselyn, in his 'New-England Rarities Discovered,' says—"At Paschataway, a plantation about fifty leagues eastward of Boston, in a small cove, called Baker's Cove, they found this kind of muscle, which hath a purple vein, which being picked with a needle yieldeth a perfect purple or scarlet juice, dying linen so that no washing will wear it out. We mark our handkerchiefs and shirts with it." But purple, being a compound of red and blue, is more cheaply dyed by the following method. The cloth must be first colored blue, by either of the methods recommended in this essay. The saxon blue (second method) gives the brightest, but least durable color. It must then be boiled with alum and tartar, as directed for yellow, and afterwards dyed with cochineal, employing from half to two thirds of the quantity required for scarlet. Or, instead of using the alum and tartar, the murio-sulphate of tin, as directed for yellow and scarlet, may be used as a mordant, and a more brilliant purple thereby obtained. Silk, previously dyed blue, by the first method, being macerated in the murio-sulphate of tin, sufficiently diluted, may be made to receive a fine and lasting purple, or violet, according to the shade of blue previously communicated, by dyeing it with cochineal. Some varieties of purple and violet may be produced by substituting madder for cochineal, but, though lasting, they will be less beautiful. Brazil wood, Nicaragua wood, and in fact whatever will color red, will give, with indigo blue, purples, often lively and beautiful, but they have but little stability.

On Cotton.—Cotton, macerated in a decoction of galls or maple bark, employing about one pound of galls to six of cotton, then dried and afterwards soaked in a saturated solution of equal parts of alum and copperas, being again dried, rinsed, and dyed with its weight of madder, will obtain a fast color, which, by varying the proportion of alum and copperas, using more alum the lighter you want the shade, may be made to incline more or less to purple or violet.

Green.—Green is a compound of blue and yellow, and we have incidentally mentioned the method of producing it, while treating of these colors. With indigo and quercitron bark, every shade of green may be given to suit the fancy, following the directions already given. When greens are produced on blues dyed by our first method, the blue part of the color will be most permanent. But the reverse happens when the saxon blue is used. In dyeing silk green, it is thought best to apply the yellow first. Employing a little logwood and sul-

phate of iron (copperas) with the yellow and blue coloring matters, will change it to a bottle green.

On Cotton.—Cotton must be alumed, &c., as directed in coloring yellow. This may be done after it has received the blue by method first. Macerating in a strong decoction of sumach, should not be omitted in the process. There are many other compound colors, which may be more cheaply produced by a direct application of coloring matters by a single process. Of such we shall now briefly treat.

Cinnamon Color, &c.—A very lasting cinnamon color may be dyed on wool, silk, or cotton, with maple bark and alum.

Hemlock bark, with alum, produces on wool a lasting bright reddish brown, and on cotton a nankin color, which is less durable. With copperas, this bark produces drab and slate colors.

Butternut bark dyes on wool, without any addition, a durable tobacco brown. With alum it will be rendered brighter, and may be fixed on cotton. With copperas, or iron dissolved in vinegar, it communicates to wool, linen, and cotton, a strong and lasting black; with alum and copperas, various shades of brown and drab. The bark of several species of walnut gives, with alum, chesnut brown; with copperas, drabs, &c.

Galls. These are excrescences produced upon several species of oak by the gall-fly. Those in common use are imported, but our farmers would do well to try those found on their own oaks, peradventure they may therein discover another source of income, for unless their use should be superseded by maple bark, galls will always find a market. We have already spoken of their use in dyeing black. It only remains to notice the light cinnamon fawn color, which galls (like many other vegetables that produce black with iron) afford, particularly on cotton, with alum. Galls communicate a durable nankin color to cotton, after the latter has been macerated in milk, dried, soaked in alum, with one eighth its weight of lime, afterwards rinsed, dried, and steeped in a decoction of this vegetable.

The bark of the cherry tree, and that of the horse chesnut, possess the property of producing a greenish olive, with copperas; and chamomile flowers are said to dye wool a durable green, with sulphate of copper (blue vitriol.)

Preparation of Wool, &c. for Coloring.—To prepare wool for dyeing, it must be macerated in warm water, mixed with one fourth of stale urine, or in a tepid solution of soap, employing one pound, with a sufficient quantity of water, to every twenty pounds of wool.

Silk.—New silk is naturally covered with a kind of varnish, or gummy substance, and generally tinged of a yellow color. This must be removed by boiling it with soap and water for one hour and a half. It is sometimes necessary to whiten it still further by the fumes of sulphur, to fit it for lively colors. The sulphur which adheres to it after this operation must be removed by soaking and agitation in warm water.

The art of applying a variety of colors to the same cloth, cotton, linen or silk, topically, either by the printing block, types, or the pencil, may be interesting to some of our fair friends who add to their accomplishments in the mysteries of housewifery, skill in drawing, and a taste for those fine arts which contribute to the embellishment of their persons. We therefore subjoin a few directions for calico painting.

Calico Painting.—Let your cloth be prepared by being well bleached, washed, dried, smoothed, and spread on a table, or stretched on a frame, as may be most convenient. Then draw with the following preparation, the parts of the figure intended for yellow, green, or red. Alum, powdered, one ounce, sugar of lead half an ounce, warm water three ounces—mix them in a phial, and shake them often for three days; afterwards add one scruple of potash, and one scruple of powdered chalk, let it stand and settle. Then pour off the clear liquor, and thicken it with gum arabic sufficiently to prevent its spreading when applied to the cloth with the pencil; add a little powdered charcoal, if you please, to the mixture, to make the drawings more visible. Let it then be thoroughly dried by a fire, heating it as much as can be safely done without scorching it. Then draw, with the following, the parts of the figure intended to be black. Take iron filings, turnings, small nails, or iron otherwise divided into small pieces, and put them into vinegar, with maple bark, or galls, sumach berries, and a little logwood—let them digest till it forms a very black ink. Mix with this ink gum arabic, till it is sufficiently thickened, and apply it wherever black is wanted, be it on the alumed parts, or on those before untouched by that mordant. Dry it by the fire as before. Do you want blue or green: Take indigo one ounce, potash one ounce and a half, quick lime half an ounce, brown sugar three ounces, and boil them in three gills of water, till the mixture loses its blue color and becomes green or yellow, with a copper-colored or blue scum. Keep it in a well stopped bottle, and when wanted for use, pour out a little in a tea cup or wine glass, and drop slowly into it muriatic acid till it cease to effervesce. Then, if it be not sufficiently thickened by the sugar, add

gum arabic, and apply it to the parts of the alumed figure which you intend for green, and to parts not alumed, intended to be made blue. Dry again, as before. If a dark olive be preferred to a black, or desired as an additional color, dissolve half an ounce of copperas in three ounces of water, and thicken it with gum arabic, and let it be applied to such parts as you wish should assume this color. Sulphate of copper, (blue vitriol,) used in the same manner, will give an olive inclining to yellow. In like manner other mordants may be applied, and a great variety of colors produced, by subsequently immersing it in a decoction of one or more dye-stuffs, as directed below. The cloth must now be soaked in warm water, in which a little ox gall has been infused, and rinsed out, without rubbing, till the gum and loose particles of matter applied by the pencil are washed out. Let it be now immersed in a decoction of quercitron bark, as directed for a yellow dye, and afterwards dipped in a mixture of warm water and powdered chalk, or weak lime water, and it will be found that the parts alumed have become a bright yellow, the alumed parts to which the indigo was applied have become green, the indigo on other parts remaining blue, the black unchanged, other colors produced on those parts upon which other mordants have been applied, and the remainder of the cloth slightly stained with the bark, which, however, will be readily removed by washing with cold or warm water, or by boiling it with water mixed with bran, and then slightly bleaching it in the sun and air on the grass. If you wish an addition of red, it may be now applied to the white or yellow parts in the following manner. Take alum two scruples, sugar of lead one scruple, nitro-muriate or murio-sulphate of tin one scruple, cochineal two scruples, water three ounces—boil them together, thicken with gum arabic, and apply it with a pencil as suits your fancy; on the yellow it will produce a scarlet, and on the white crimson. If instead of using the quercitron bark, you dye the cloth with madder, or Nicaragua wood, the alumed parts will become red, the indigoed purple, &c.

The preceding essay has been carefully, though hastily, compiled from Bancroft's Philosophy of Permanent Colors, and several other treatises on coloring, of good authority. Many of the methods directed we have proved correct, by experiments of our own, and we confidently recommend them to all interested. If the directions given be carefully followed, we doubt not any of the above colors will be obtained in a good degree of perfection. Good dye stuffs, of the kinds mentioned, will be indispensable to success. To distinguish the true quercitron from the bark of other oaks which nearly resemble it, you will do well to soak a small piece of it either in your mouth or warm water, and dip it in the murio-sulphate or other solution of tin. If it be the right kind, it will instantly show the brilliant yellow which it gives to cloths.

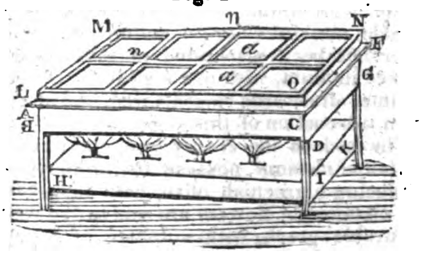
[From the Journal of the Franklin Institute.]

Experimental Illustrations of the Radiating and Absorbing Powers of Surfaces for Heat, of the Effects of Transparent Screens, of the Conducting Power of Solids, &c. By A. D. Bache, Professor of Natural Philosophy and Chemistry, University of Pennsylvania.

Among the very interesting phenomena of heat, there are many which are with difficulty brought under the eyes of a class, so as to render them satisfactory to each one by the test of sight. The thermometer, even when constructed on a large scale, affords but an inadequate means of rendering evident the temperature of bodies, to those who are distant from the lecture table, and the illustrations made by its use are, at best, rather tame. When the temperatures to be indicated admit of it, lecturers have, in preference to using the thermometer, resorted to the freezing of water, to the melting of wax, to the inflaming of phosphorus, the boiling of water, &c., as more adequate means of rendering evident the temperatures in question.

The instruments about to be described, I have found very convenient for class illustration, and always to afford satisfactory evidence of the positions to be proved. The first instrument is intended to show the powers of different surfaces in radiating and absorbing heat, with other phenomena, which will be referred to in the sequel.

Fig. 1.



To produce a sensibly uniform temperature, a prismatic vessel, A B C D F G, fig. 1, of sheet iron, of a convenient size, is filled with melted tin, and covered at top by a plate of sheet iron, A F; or, in preference, by a plate of cast iron, of moderate thickness. The temperature of the tin is

kept up by an alcohol lamp, H I K, with several wicks, fitting below the box, and between the legs which support it; by this means, the top radiates heat of considerable intensity. I prefer the use of tin, in the box, to that of oil, on account of the greater cleanliness resulting from its use, and because the oil gives off an offensive smell at high temperatures. Boiling water does not give a sufficiently high temperature to produce rapid action in the apparatus, and the greater exactness with which it would yield a constant temperature is not necessary in such an illustration.

A rectangular frame, L M N O, made of dry wood, to prevent its warping, of a small height, L A, and of a length and breadth such as to adapt it to its place upon the cover of the box, A G, is divided by cross pieces of wood into small squares, or rectangular compartments, as *n n*, the upper surface of the frame being perfectly plain, and parallel to the cover, A F, of the box containing the melted tin; this frame is intended to support, without the necessity of contact with each other, small plates of thin metal, or other appropriate material, the surfaces of which are variously coated.

To show the *radiating powers of different surfaces*, any convenient number of thin plates of sheet lead, or sheet tin, or mica, are cut to suit the size of the squares, *n n*, of the frame, overlapping the inner edges, but not extending to the middle of the small dividing bars of wood; each one of the plates has one of its surfaces differently coated; supposing them to be of lead, one is coated with lampblack, another brightened by sand paper, or coated with tin leaf, another left tarnished, a fourth coated with gold leaf. Being placed upon the frame, as at *a, a*, with the coated sides uppermost, small bits of phosphorus are placed upon the middle of the plates, and the frame put in its place upon the cover, A F. The surfaces which absorb the heat radiated by the cover, A F, being the same, the material and thickness of the plates being the same, the circumstances are alike in each plate, except so far as the upper surface is concerned; the plate which is coated with the worst radiator, will become warm first, and the phosphorus will melt first upon it, and, generally, the order of melting of the phosphorus will indicate the inverse order of the radiating powers of the surfaces. As the heat radiated from the cover is high, the melting of the phosphorus will be soon followed by its inflaming, and the order thus given will hardly deviate from the first; the interference from the film of oxide, which is so annoying in the modification of the apparatus of Ingenhousz, for illustrating the relative conducting powers of bodies, is almost entirely obtained by the high temperature of the source of heat. To avoid injuring the coated surfaces, a thin film of mica may be placed below the phosphorus, the film being large enough to prevent the effect of the spreading of the phosphorus, as it burns.

The plates should be made thin, in order that the results may be mainly dependent upon differences in the radiating power of the surfaces. I have used plates of thin sheet tin, (iron coated with tin,) of sheet zinc, and of glass, with good effect. The effects may be accelerated by coating the under surfaces with lampblack, to promote the absorption of heat; but in that case, care should be taken that the thickness is at least equal to that which produces the greatest amount of absorption.

Instead of the pieces of phosphorus, wax, or other readily fusible material, may be used, as in the apparatus of Ingenhousz; or cones of wood, weighted at the base, and kept upon the plate, with the vertex downward, by a fusible material, may be substituted.

It may happen that the lecture table is so arranged as to render it advantageous to incline the cover, A F, of the box, A G; this will be readily accomplished by making the cover part of the box itself, in which case the melted metal may be introduced through a hole in the higher side; as, for example, in A D.

To illustrate the fact that *absorption and radiation are proportional*, the same square plates, *a a*, &c., may be used; the variously coated surfaces are placed downwards, phosphorus is put, as before, on the upper surfaces, and the frame deposited in its place upon the cover of the box. The phosphorus will now melt in the inverse of the order shown in the first experiment, the plate having the best absorbent surface heating first. If plates of metal be used, their upper surfaces should be bright, for this illustration; but glass, or mica, which will allow the coating to be seen through, is best adapted to the purpose.

The fact that the *radiation*, or *absorption*, of heat, *does not take place merely at the surface*, but at a definite thickness, which becomes very appreciable in good radiators, may be satisfactorily shown by coating the surface of one of the plates with a thin layer of lampblack, and another one with a considerable thickness of the same material. If the coatings be upwards, as in the first illustration, the phosphorus will melt soonest upon the thinly coated plate; if the coatings be downwards, as in the second illustration, the reverse will be the case.

The *effect of transparent screens* in pre-

venting the passage through them of heat not accompanied by light, may be shown by using, in the same instrument, plates of glass, mica, &c., of equal thickness; theoretically, the differential results are not as free from objections as the former ones; but the fact is illustrated almost unexceptionably, since the phosphorus melts first at the surface of the plate, which it would not do if the plate were cool, and the fusion resulted from the absorption, by the phosphorus, of the heat which had passed through the screen of glass, or mica.

These illustrations I have tried repeatedly, and successfully; there are others of a more refined character, which I have not yet had an opportunity to attempt, but which, I doubt not, might be carried out very easily. The first of these is the curious property discovered in rock salt, by M. Melloni, of permitting the passage of heat of low intensity, as freely as that of high; a piece of phosphorus placed upon the salt, and another upon a thin film of mica, the under surface of which should be coated with lampblack, just above the plate of rock salt, would serve to show this property. That transparent plates of mica are only partially diathermous, would be shown in a similar way, and, in fact, by the relative periods of fusion of the phosphorus just above the plate, and of that upon it, a notion of the relative quantities of heat stopped and transmitted might be furnished.

Another illustration which I have tried with success, is that of the want of specific effect of color on the absorption of non-luminous heat: a fact which some researches, undertaken by Professor Courtenay and me, and not yet published, indicate. On coating the plates on one side with lampblack, plumbago,* white lead, chalk, prussian blue, vermillion, &c., it will be found that the phosphorus melts upon them without regard to the order of color. Care should be taken that the thickness of the coatings is such as to give to them each the maximum radiating or absorbing power; a thickness which will differ for each material, but which may, for all, be very easily exceeded.

By a change in the character of the plates, this instrument may be used to advantage in showing the experiment devised by Franklin, and executed first by Ingenhousz, for indicating the relative *conducting powers of solids* for heat.

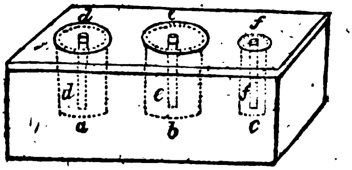
That the experiment just referred to does not truly give the relative conducting powers of bodies, can, I think, be clearly demonstrated, notwithstanding that it is found, in all the books, in juxtaposition with the very elegant and accurate method proposed by Fourier; with the explanation of its intrinsic defects, it may be, however, still admitted as a general illustration. To apply the instrument, plates of the same thickness of the substances to be tested, as, for example, of tin, iron, lead, copper, pottery, wood, glass, &c., which can be easily obtained in the requisite form, are to be coated on both sides with a thick coating of lampblack, or other good absorbent and radiator, leaving a small strip of the upper surface bare, to exhibit the nature of the material; the plates having phosphorus placed, on mica, upon them, are put upon the frame, and this is placed on the cover of the box: the order in which the phosphorus fires, gives the same indication as in the apparatus of Ingenhousz. This effect is more rapid than when cones, or rods, are used, especially from the lower temperature of the substance which is commonly used as a source of heat. These remarks do not apply, of course, to the forms of that apparatus in which hot sand is used.

The second instrument to be described is intended to show the common illustration of the fact that bodies have *different specific heats.*

Theoretically, this illustration is, I think, inaccurate, but is *admissible,* like the last; upon this subject, I hope to be able, at a future time, to be more explicit; at present, my remarks are confined to general illustrations. That different bodies require unequal quantities of heat to raise their temperatures through the same number of degrees, is illustrated upon equal weights, or bulks, by subjecting them, when at the same temperatures, to the same source of heat, and proving that they require different times to arrive at the same temperature. This idea is a fundamental one, and cannot too early be inculcated upon a learner. As an illustration, I have three vessels of sheet iron, to contain equal *weights* of mercury, alcohol, and water; these are fastened to a frame, by which they can be dipped into the same vessel containing hot water. An alcohol thermometer, with a column of fluid large enough to be visible at a moderate distance, dips into each vessel. As the heat enters, the thermometer in the mercury rises with great rapidity, that in the alcohol more slowly, and that in the water lags behind both the others. Instead of those thermometers, if a cylinder of any metal which is a good conductor, and has a low specific heat, such as copper, for example, should, after being coated with a varnish of thickened linseed oil to protect the surface, be introduced into each vessel, phosphorus placed on the top would melt and inflame first on the metal which dipped

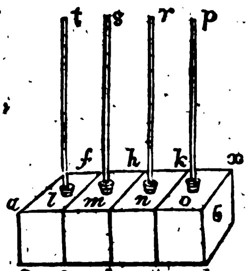
into the liquid having the least capacity for heat. In the annexed cut, fig. 2, *a*, *b*, and *c*, are the vessels; *d*, *e*, *f*, metallic cylinders resting in wooden, or metallic, or mica, disks, and the whole dipping into a vessel, *m n*, of boiling water. The mercury is so small in bulk, that the influence of this strikes the student immediately; but the idea which he thus catches at, is refuted by the more tardy heating of the water, which is less in bulk than the alcohol.

Fig. 2.



Before the forms of illustration, of the radiation and absorption of heat, already described, had suggested themselves, I had contrived another apparatus, which gave very good results, and may be, by some, preferred to the one already described. A long box, *a b c d x*, of tin, was divided into compartments by partitions, *e f*, *g h*, *i k*, &c., and a top soldered upon each, having

Fig. 3.

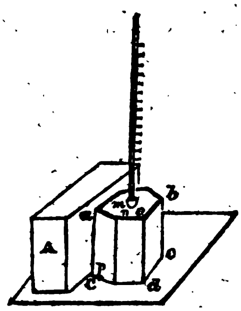


a conical opening, *l*, *m*, *n*, &c., to receive a cork, through which a tube, *o p*, *n r*, *m s*, *l t*, &c., passed; these compartments were made as nearly equal as possible, and the tubes entering them were selected of as nearly equal bore as possible; equal measures of colored water were poured through the conical openings into the several compartments, so as to cover the bottom to a depth regulated as will be presently stated. The tubes and corks were now inserted, and cemented; and each cell thus formed an air thermometer, the expansion of the air within driving the colored liquid up the tube entering the cell. That there might be no error from a want of equality in these thermometers, after bringing the liquid to a convenient height in each of the stems, by forcing air into each, or by dropping liquid from a dropping tube into the tube, the whole was plunged into a vessel of water, of a temperature sufficiently above the original temperature of the air within, to give distances on the tubes, readily divisible into equal parts of sufficient magnitude. These degrees were marked by a rude scale, formed by colored threads, tied around the tubes. One surface of the box was kept uniformly bright, or regularly tarnished, or coated; the other, *a d*, was coated with substances of different radiating powers.

The box being placed with the uncoated side towards a vessel of warm water, the heat enters uniformly that side of the compartments, but is radiated differently from the opposite side, and the liquid from the air thermometers is urged more rapidly up those tubes which enter into the compartments radiating worst, and ultimately arrives at a greater height, showing a greater stationary temperature, or temperature of equilibrium, between the heat absorbed and that which is radiated. If the vessel be now turned, so that the variously coated surfaces are towards the source of heat, the liquid in those coated with the best absorbents will immediately begin to rise in the tubes, and that in those coated with the worst absorbents, to fall. That the two lateral compartments are exposed to a greater cooling action than the others, may be an objection to this apparatus; but it is easily obviated, and with it the communication of heat from one compartment to another, by terminating the box at each end by a small compartment, and separating each of the other compartments of a similar space; in fact, convenience alone was the reason for uniting these air thermometers in one vessel.

Another form of apparatus, which is more simple, I have found convenient; but it occupies more time than that last described, in obtaining the same result. A

Fig. 4.



prism of any convenient number of sides, is made into an air thermometer, in the

manner described in speaking of the last apparatus; the sides are variously coated; it fits loosely into a prism of the same form, but wanting one side; in the figure, *a b c e*, represents the enveloping surface, and *m n o p*, the air thermometer. To show the different absorbing powers of the different substances, the vessels described are placd as in the figure, before another, A, containing hot water, hot sand, or any other convenient source of heat. Supposing the side of the air thermometer, which is the worst absorbent of heat, to be exposed to the source of heat, the air within is expanded, and the position of the liquid in the tube is marked by an index; a better absorbent is exposed, and the liquid rises higher; a worse, and it falls below its original level; the experiment can thus be varied at pleasure. The outer sheath, or covering prism, serves to render the surface, not exposed to the source of heat, uniform in its radiating powers, and to protect those sides which are not intended to be exposed to the source of heat, from the radiation of the vessel, A, which, otherwise, would affect them sensibly. If the air thermometer were a rectangular prism, of course the objection just stated would not apply; but the sheath would still be necessary to equalize the radiation from the surfaces not exposed to the source of heat.

To show the radiating powers of the different surfaces, the sheath is turned so that the open side is exposed to the air; the absorption of heat now becomes sensibly constant, and the greater or less height of the liquid in the tube is determined by the less or greater radiating power of the exposed surface.

The order in which the surfaces are exposed may, of course, be so arranged as not to require the temperature of the source of heat to be kept constant.

Such an apparatus, placed before a stove, would make an admirable illustration in a school; or a vessel of water, colder or warmer than the room, may be used as the radiating or absorbing body. For the tin vessel here described, a common square glass bottle may be substituted, without disadvantage. Even a common glass phial, made into an air thermometer by inserting a tube through a tight cork, into some liquid occupying the lower part of the phial, and provided with a moveable coating of tin foil, gilt paper, writing paper, and paper covered with lampblack, when placed before a fire, or in a room of which the air is warm, when the external air is cold, brought near a window, will afford an interesting and instructive illustration.

Philadelphia, February, 1835.

[From the American Railroad Journal.]

Remarks on the Substitution of Locks for Inclined Planes.

In my last communication on this subject, I stated that the extra cost of constructing the locks in question was more than counterbalanced by advantages not yet enumerated. One of these is found in the circumstance, that the locomotive moves continually with the train throughout the whole route. Where inclined planes are employed, the danger and difficulty of passing the engine over them are so great, that the attempt is rarely, if ever, made. The consequence is, that at each plane the locomotive, which propels a train of cars, must be exchanged for another previously heated, so that a much greater number must be kept in immediate preparation for use than though this necessity for change did not exist.

But the principal advantage to which I alluded as overbalancing the extra expense of constructing the locks in question, is the diminution of the expense of grading, which would result from their adoption. The annual expenditure of a stationary engine being so very great, and that expenditure being nearly the same, however inconsiderable the height to be ascended, it becomes a matter of great moment that the whole elevation should be made at one point so as to require but one stationary engine. But Nature, in moulding the earth, evidently did not fashion its surface with a view to the most economical and convenient construction of inclined planes. The ascent from low to high grounds is frequently extended, either gradually or by successive partial elevations, through a distance of miles. Under these circumstances, by means of deep excavations and high embankments, the ascent is concentrated into a short space, and is then overcome at once by means of an inclined plane and stationary power. This occasions an immense cost, the greater part of which might have been avoided by the use of locks. In this case there would have been no necessity of making the whole ascent at once. It is wholly immaterial whether the locks necessary for this purpose are placed contiguous, or at the distance of miles from each other. We can, therefore, accommodate our work much more nearly to the natural surface of the ground, and

thus each lock will probably save more than sufficient to defray the expense of its construction.

The recommendations of the locks in question, therefore, are: first, economy in the construction of the road by diminishing the expense of grading; secondly, economy in the operation of the road, by dispensing with stationary engines, by enabling the same locomotive to continue on through the entire route, and also to move a greater load, since the facilities of rising perpendicularly are rendered so great that it will be practicable to lay the rails more nearly horizontal than at present. These advantages would all be felt, though no difference were made in the direction of the route in consequence of the adoption of this system, and would abundantly recommend its introduction. But these are not all. The dread of engineers for every slight elevation being overcome by dispensing with the necessity of inclined planes, it will be readily perceived that the route of a railroad may be made much more direct than at present, and thus not only the expense of constructing many miles of road, but the cost and time of transportation over it, be curtailed; and, finally, the danger to which life and property are exposed in passing over inclined planes will be almost entirely annihilated.

The only objection of any validity which I have heard urged against the locks in question is, that they have never been tried. That caution, which serves as a barrier to the introduction of visionary schemes and unsubstantial novelties, is a most useful quality; but in the present case we seek to introduce nothing new, but only the application of known powers and principles in a new method and for a new purpose. The properties of the screw and the powers of a steam engine are both well tested and understood. If, by means of the former, a few men are able to raise the largest ships, can any one doubt that the same power, properly applied, would raise a few railroad cars of one half the weight? And if human strength can effect this, will there be any scepticism as to the efficacy of a steam engine in producing the same result? There is no room for doubt; there is no possibility of a failure. But to make assurance doubly sure, let us enter into a brief mathematical estimate. The proprietor of the screw-dock in this city has informed me, that fifty men are sufficient to man all the screws at once, and that they will easily elevate a ship weighing two hundred tons a height of two feet in the space of thirty minutes. Now, the engines employed on the Liverpool and Manchester railway are of 30 horse power. What ours are in general, I know not, but let us suppose them to be of 20 horse power. One horse is generally reckoned equivalent to six men. Suppose we say five, and the power of our engine will then be equivalent to that of 100 men; but when our engine is said to be of 20 horse power, the velocity of that power is supposed to be 20 miles per hour—call it fifteen—the velocity of human power does not exceed 2 miles per hour. The effect of a given power is proportional to its velocity, so that the power of 100 men, provided it moves at the rate of 15 miles per hour, is the same as that of 750 men moving only two miles per hour. The effective power of our steam engine is, therefore, 15 times as great as that employed in raising ships on the screw-dock. But the weight we shall wish to elevate will never exceed 100 tons, or one half the weight of a large ship. The proportion between our power and weight is, therefore, 30 times as great as in the case of the screw-dock. If, therefore, in the latter case, they can raise their weight 10 feet in 30 minutes, we shall be able to raise ours the same height in 1 minute, or 30 feet in 3 minutes.

M.

[From the London Mechanics' Magazine.]

Substitute for Canal Locks.

Sir,—A short time since I read an extract from the Taunton Courier, (the date and particulars of which have escaped my memory,) which announced the opening of some branch canal in that part of the country, of about four miles in length; on which canal machines called "*lifts,*" said to have been invented by Mr. Green, the engineer, have been introduced in lieu of the present mode of lockage. Now, if I mistake not, a similar machine was invented as many as twenty years ago, and actually brought into action by a person of the name of Woodhouse. But whether Green borrowed the idea from Woodhouse, or Woodhouse from Green, it is impossible for me to say. I

know it was considered at the time quite a new thing. However, it was found not to answer the intended purpose, being too complex, and too expensive for universal adoption. I should be highly gratified if some of your numerous correspondents would produce a drawing and description of one of these "*lifts*," for insertion in your journal; and I am sure there are hundreds besides myself who would be equally gratified.

If I might be allowed to state an opinion, I should say this mode is *inferior* to the old mode of *lockage*. Twenty or thirty tons is a weight which must require machinery of an immense strength and power to transport from one level to another, often differing from six to eight feet; and, as a natural consequence, the time lost must be considerable—much more, I should imagine, than by the present mode of *lockage*. To be sure, in short water seasons, like the last, they would be found highly valuable, as at such seasons loss of time is nothing compared with a saving of water. The past has been a trying season for canals, and the expense incurred by many of the companies has necessarily been very great. I have been told it has cost some of them as much as £3 *for every lock of water!* and that, too, for a *considerable length of time!*

I am, &c. J. L.

Bulbourne, March 23, 1835.

On Canal Navigation, by John Macneil, Esq.—We have been favored by a scientific gentleman of this city with a treatise on the subject of canal navigation, or the "*resistance of water to the passage of boats on canals*," by John Macneill, Esq., Member of the Society of Civil Engineers, London, which gives a series of results that will appear incredible to those who are not familiar with great speed in canal navigation. There are many persons who will require further evidence before they will believe that navigation can be carried on on canals at the rate of 10 to 14 miles per hour, without injury to the banks, and that too on a canal narrower than the canals of this State; and many others who will hardly credit the theory, that the resistance will be less on a *narrow* than *broad* canal; yet such appears to be the opinion of those who have examined the subject, and experimented upon it. The following is the introduction of Mr. Macneill.

The results which I have arrived at by experiments are so much at variance with generally received theoretical deductions, that it is with much diffidence I submit these pages to the consideration of the public, and to those more immediately concerned in Inland Navigation. The following observations are made with a hope that those discrepancies between theory and practice may tend to a more rigid adherence to experimental inquiries in other branches of practical science, but especially, that they may lead to a more varied and extensive series of experiments to ascertain the best form of boats, not only at the cost of public companies, whose canal property may well demand it, but also at the expense of government, who lay out large sums in steam navigation; for I trust it is clearly shown, that very great alterations and improvements may be made in the models of all ships and boats which are not impelled by the wind, and that passengers and light goods may be carried by canals at a velocity hitherto supposed to be impracticable.

On the Resistance of Water to the Passage of Boats on Canals, &c.

The laws which regulate the resistance and impulse of fluids are involved in such obscurity, that candid investigators of this branch of science are compelled to confess that the dissertations of the physico-mathematician have failed in utility, and that even the deductions of the logician have been almost altogether ineffectual. The assumptions of the former, from which propositions have been deduced, and theories given out, are, at best, founded only on an hypothesis; the reasonings of the latter rest upon limited experience, and, in some cases, ill observed phenomena. And there is probably no branch of science which has so much engrossed the attention of the philosopher, and from which so little practical good has resulted.

That such is the fact, and that the farther the subject has been investigated, the more difficulties have been met with, if not always acknowledged, few can venture to deny.

If, in his zeal for information, the inquirer of the present day searches the shelves of philosophy, his labor will terminate in the settled conviction that this branch of science is but yet in its infancy, even although illustrated by the novel algebraical calculus, and the beautiful results derived from it by French ingenuity. A long course of patient experiment will alone warrant the adoption of formulæ; for as yet, as far as re-

gards the mere resistance of the fluid, the practical application of the laws founded by the mathematician has failed in producing any form which will rival the skiff of the Indian, the canoe of the Esquimaux, or the junk of the Chinese.

These observations apply to all boats and ships impelled by any other force than the wind; and this must not be forgotten, whilst we proceed to examine one particular department, viz. canal navigation. Every body moving in or upon the water, it will be seen, is under similar laws; and although the following results apply particularly to canal boats, they, nevertheless, are applicable to every other body which has to make its course by water.

The object immediately in view, when we place a boat or barge upon water, is a good conveyance for persons and property. So is it when we place a wheeled carriage upon a gravelled road, or a sledge upon snow. The difference, however, in the modes of attaining this object, has been most striking. In each of these cases, the body to be moved has been rested on soft or yielding matter, and whilst, in the two latter cases, no mechanician would provide for the wheels of the carriage, or the runners of the sledge, a facility for cutting along, immersed in the softer matter under them, the boat-builder seems to have studied how he could best keep his vessel ploughing her way. The case may be different with sea-going vessels, which are impelled by the action of a wind "on the beam," and ships of war, with their decks loaded with weighty guns; in such cases it is necessary that the vessel be a good deal immersed. Nor can it be satisfactorily shown, that even sea-going ships would not be improved by such a build as would enable them to rise to the surface of the water. But to pursue our *reductio ad absurdum:* there are many cases in navigation, where a sharp "cut-water" shape to a boat would be as unphilosophical as a knife-edged felloe would be to a wheel intended for ploughed land. A cart-wheel will, on gravel or other yielding matter, sink to the determined line of gravitation with as much certainty as will a boat upon water; and a boat resting in water will (according to the velocity given to it, and the form of its prow and bottom,) rise nearer the surface of the water, as well as a cart-wheel will rise when put rapidly into motion. The difference of density is, no doubt, much greater in one case than in the other; but the water will resist the penetration of the boat in the same manner, though not in the same degree, as the soft gravel or mould resists the wheel. Notwithstanding a conclusion so obvious to those who know the laws of gravitation, and the properties of matter, so easily calculated by every one who understands any thing of the combination of forces,* we find it has been neglected in order to determine what law regulates the movement of a body immersed to the same depth, at all velocities.

At a time when it was generally held, that the resistance to a vessel in the water increased in the duplicate ratio of the velocity of the vessel through the water, the now keenly contested merits of railway transport, and canal transport, were brought under public discussion. Experiments were instituted in order to confirm this law of resistance, but it occurred to none of the experimentalists that, although they could not increase the density of the water, or harden it, as has been done with roads for carriages, that they could still increase the relative resistance of water, by giving the boat such velocity that her prow could not penetrate fast enough, and thus that she should rise out of the fluid. They might have reasoned, by a perfectly fair analogy between conveyance on land or on snow, and conveyance on water, and have legitimately concluded that, as their object was not to cut through gravel, but to get on it, in the one case, so at high velocities, in the other, they should not have endeavoured only to cut through the water, but also to raise the boat to the surface, and make her skim thereon.

Such facts are obvious to all, who have seen a boy make a thin stone skim the surface of a lake,—who have watched the action of a cannon ball on the smooth sea,—who have felt the difficulty of making any impression upon the stream forced from the small aperture of a fire-engine hose-pipe,—or, indeed, who know any thing of the properties of matter; but they had never been applied to the purposes of navigation, until it occurred to Mr. Houston, of Johnstone Castle, to try the effect of a light gig-shaped boat upon a canal; and it is very surprising that the most strenuous advocates for the adoption of such boats still reject the above facts, as irrelevant. It matters not whether the water be forced against the object, or the object be forced against the water.

In the month of June, 1830, Mr. Houston

* We find a good illustration of this resistance in "A Winter in Lapland and Sweden by Arthur de Capell Brooker, 1727," p. 338.—"The real superiority of the skielobere is chiefly shown when the enemy halt after a long march. Whatever precaution may then be taken, they are in constant danger from troops which have no occasion for path or road, and traverse with indifference marshes, lakes, rivers, and mountains. Even in those parts where the ice is too feeble to bear the weight of a man, the skielobere glides safely over, by the mere rapidity of his motion."

succeeded in having a light, long, and shallow wrought-iron canal boat established upon the Ardrossan canal, in Scotland, between Paisley and Glasgow. Since that period, such boats have continued to run regularly, conveying about sixty passengers a distance of "twelve miles, at a rate of eight miles an hour, stoppages included." Succeeding improvements in the construction of the boat, as well as in the mode of working the horses, enable us to state the above as a minimum of performance. In the Appendix, A, (page 94,) will be found a specification of one of such boats, and the annexed figure shows their form and dimensions. The following quotation from the advertisements, the truth of which is well authenticated, shows the cheap rate of conveyance.

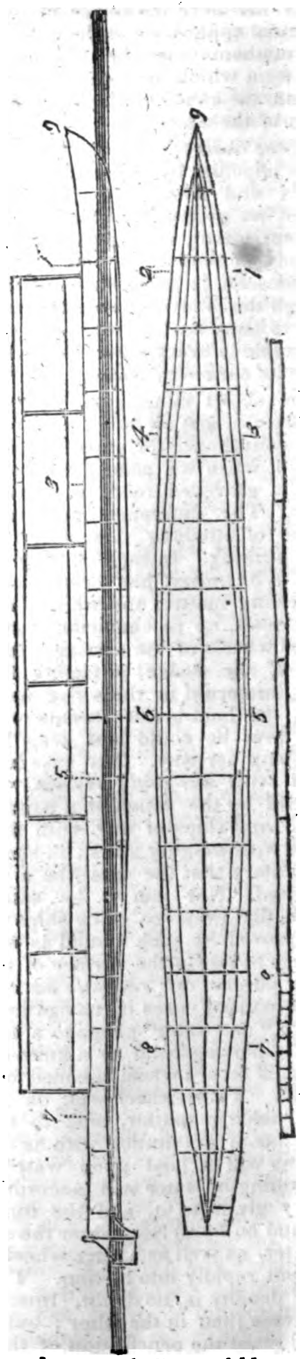
	Distance.	Cabin.	Steerage.
"Fare between Glasgow and Paisley...........	8 miles.	9*d.*	6*d.*
Fare between Glasgow and Johnstone...........	12 "	12*d.*	9*d.*
Fare betweeen Paisley and Johnstone.............	4 "	5*d.*	3*d.*

Intermediate distance as in the way-bill.

"The boats, at times, carry twelve hundred passengers in one day; and during eight months of last year, (1832,) notwithstanding the prevalence of cholera, they conveyed one hundred and twenty-six passengers, which is at the rate of fifteen thousand seven hundred and fifty, monthly."

Mr. Thomas Grahame, in his "Letter to Canal Proprietors and Traders," says, "The experiments of great velocity have been tried and proved *on the narrowest, shallowest, and most curved Canal in Scotland*, viz. the Ardrossan or Paisley Canal, connecting the city of Glasgow with the town of Paisley and village of Johnstone, a distance of twelve miles." The result has disproved every previous theory as to difficulty and expense of attaining great velocity on canals; and as to the danger or damage to the banks of canals by great velocity in moving vessels along them.

"The *ordinary speed* for the conveyance of passengers on the Ardrossan canal, has for nearly two years been *from nine to ten miles an hour*, and *although there are fourteen journeys along the canal per day, at this rapid speed, the banks of the canal have sustained no injury.* * * * * * The boats are formed seventy feet in length, about five feet six inches broad, and, but for the extreme narrowness of the canal, might be made broader. They carry easily from seventy to eighty passengers, and when required, can, and have carried, upwards of one hundred and ten passengers. The entire cost of a boat, and fittings up, is about £125. The hulls are formed of



light iron plates and ribs, and the covering is of wood and light oiled cloth. They are more airy, light, and comfortable, than any coach. They permit the passengers to

move about from the outer to the inner cabin, and the fares per mile are *one penny* in the *first*, and *three farthings* in the *second cabin*. The *passengers are all carried under cover*, having the privilege also of an uncovered space. These boats are drawn by two horses (the prices of which may be from £50 to £60 per pair) in stages of four miles in length, which are done in from twenty-two to twenty-five minutes, including stoppages to let out and take in passengers, each set of horses doing three or four stages alternately each day. In fact, the boats are drawn through this narrow and shallow canal at a velocity which many celebrated engineers *had demonstrated, and which the public believed to be impossible*."

Mr. Grahame then proceeds making apparent his want of confidence in railways—"The entire amount of the whole expenses of attendants and horses, and of running one of these boats four trips of twelve miles each (the length of the canal), or forty-eight miles daily, including interest on the capital, and twenty per cent. laid aside annually for replacement of the boats, or loss on the capital therein invested, and a considerable sum laid aside for accidents and replacement of the horses, is 700*l.* some odd shillings, or taking the number of working days to be three hundred and twelve annually, something under 2*l.* 4*s.* 3*d.* per day, or about 11*d.* per mile. The actual cost of carrying from eighty to one hundred persons, a distance of thirty miles, (the length of the Liverpool railway,) at a velocity of nearly ten miles an hour, on the Paisley Canal, one of the most curved, narrow, and shallow canals in Britain, is therefore just 1*l.* 7s. 6d. sterling. Such are the facts, and incredible as they may appear, they are facts which no one who inquires can possibly doubt."

The following is a statement I am enabled to publish showing the gross expense of running old heavy boats on the Paisley canal* at the rate of four miles per hour, and new light boats on the same canal at the rate of ten miles per hour, and the comparative expense per mile; also the number of passengers carried before and after the introduction of the high and cheap speeds.

	Speed pr. hr.	Number of passengers carried.	Number of miles run each day.	Whole expense per year.	Cost pr mile, year taken at 312 days.
1830. . .	4	32831	48	700*l.* 4*s.* 7*d.*	11*d.*
1831. . .	10	79455	vary'g	1316*l.* 17*s.* 5*d.*	—
1832. . .	10	148516	152	218*l.* 5*s.* 11*d.*	10¼*d.*

NOTE.—The charges for the year 1830 are the bare outlays; and those for 1831 and 1832 include loss on purchase and sale of additional horses, and ten per cent. on cost of horses, boats;-deposited in a contingent fund.

The power of conveyance thus established on the Paisley canal, may be judged of from the fact that on the 31st of December, 1832, and 31st of January, 1833, there were conveyed in these boats nearly 2,500 passengers.

The number of passengers continue to increase. The number carried in April, 1833, was twenty thousand, or at the rate of two hundred and forty thousand yearly.

It does, therefore, appear surprising, that canal owners in particular, whose property was daily becoming less valuable in the share market, by the alleged superiority of railway conveyances, should have been so blind or supine as to allow nearly three years to pass over, without making vigorous efforts to follow the successful example; but it is not the less true that they were, and indeed are still so; although, if the system be a good one, and practicable, and lucrative, as to me it appears undoubtedly to be, they could not have hit upon a more happy arrangement for keeping up their dividends, and for improving their property to a greater extent than it has arrived at, since the commencement of canal navigation in England. In many situations throughout the kingdom, where the quick transit of passengers, and even of light goods, was of consequence, it would not only enable the canal companies to compete with existing turnpike roads, but also to supersede the necessity for railways for general purposes.

We must suppose that canal proprietors did not credit the various reports in circulation as to the speed at which the boats were drawn upon the Paisley canal, the ease with which horses perform their work, and the small surge produced on the sides of the canal. But even supposing many of these reports to be exaggerated, and that false conclusions were come to by those who witnessed the performance, the great points of speed and economy were established to the satisfaction of many inquirers. Had the facts been known to canal proprietors, we should have expected the institution of a series of experiments long ere this, for ascertaining the actual resistance of boats at high velocities, and under every variety of circumstance, as well as the best form of boat suited to these velocities; the height of the wave or surge, as well as its character and effects, and many other important features, which were now for the first time exhibited.

It is most unaccountable why canal companies did nothing to determine such; and it is to be hoped they may now be induced to institute extensive experiments. The few experiments which are detailed in the following pages, though made with as much

accuracy as circumstances would admit, and though they are conclusive on some points, are by no means as extensive and varied as the importance of the subject demands. The scale of expenses was so exceedingly limited that they could not be carried farther, and others of still greater importance have not, in consequence, been undertaken, and remain yet to be made.

The energy and inquiring habits of Mr. Telford would not let such a practically useful inquiry remain dormant. He therefore directed me to make some preliminary experiments on a small scale, and to his liberality we are indebted for the first series, which were made entirely at his expense, in the National Gallery of Practical Science in Adelaide street; where the arrangements of the room were so admirable, and the accommodation, which the managers of the Gallery always gave for uninterrupted experiment during three weeks, was such,* that the most accurate results were obtained on a limited sheet of paper.

Figure 1 represents the plan and elevation of the reservoir of water in the National Gallery of Practical Science in Adelaide street, with the apparatus which was fitted up by Mr. Saxton, for the purpose of making the experiments. The straight part of the reservoir is seventy feet long, and four feet wide, with upright sides. The wheel and axle, B & *b*, were of excellent workmanship; the axle on which the weight acted was of hard wood, three and a half inches in diameter, and the wheel on which the line that pulled the boats was coiled was of brass, thirteen inches in diameter; the axis on which the wheel and axle turned was of polished steel, half an inch in diameter, working in brass. The pulley or sheave F, *f*, which was attached to the tin box or can, C & *c*, which held the weights, was of brass, two and a half inches in diameter, and its axis was of steel, with conical points working in brass. The line used for the weight was of catgut, one eighth of an inch in diameter, and the lines used for pulling the boats were, in some of the experiments, of silk, in others hemp, varying in thickness from one fortieth to one twentieth of an inch in diameter. The tension of the line in each experiment, or the force which was exerted on the boat by a given weight, placed in the bucket C & *c*, was not determined by calculations, but practically and accurately ascertained, not only by a spring dial placed on the line as at *f*, but also by an accurate beam and scales, furnished by Mr. Simms; by which means any mistake or inaccuracy in estimating the quantity of power was effectually prevented. The boat is seen at (*a*, *a*,) as she appeared in her passage from one end of the straight canal to the other; the moving power being the weight in the bucket (C & c.)

In making some preparatory experiments it was found that a considerable space was necessary to be passed over by the boats, from the point of starting, before they acquired a uniform velocity. It was therefore found necessary to limit the distance over which the uniform motion was measured, to a space of fifty feet, and consequently, great accuracy was necessary in determining the time of the boat's transit over so short a space. I therefore applied to my friends, Messrs. Arnold and Dent, the celebrated chronometer makers, in the Strand, who, with that liberality which usually accompanies science, not only furnished me with chronometers, but Mr. Dent himself, more than once, assisted in measuring the time, and comparing it with that observed by Mr. Turnbull and Mr. Bourns, whose accurate and careful observations have contributed so much to the success of these experiments.

Occasionally two, and sometimes three chronometers were used, placed as at (*h*, *h*,) on brackets, screwed to the side of the reservoir, at the commencement and at the end of the measured space.

Close to these chronometers, and exactly at fifty feet apart,* two brass wires were stretched across the reservoir, at eight inches above the surface of the water; by means of which wires the observers could determine the exact instant of time that the bow of the boat came under them, as they were slightly touched by a slender piece of brass wire, rising perpendicularly from the stem of the boat.

In some of the first experiments it was found extremely troublesome to ascertain the exact interval of time of the boats passing between the wires, in consequence of the chronometers having different rates of going; but this difficulty was obviated by a suggestion of Mr. Cubitt, who proposed that, after a certain number of experiments, the place of the chronometers should be changed, and the experiments repeated. This effectually obviated the difficulty, and enabled us to get the time with great precision. In the latter experiments, only one chronometer was used; it was placed on

* Every gentleman who witnessed the experiments, and saw the facilities with which the Committee and their manager, Mr. Payne, gave, agrees with me in bearing testimony to the liberal and philosophical spirit with which we were aided. They not only allowed a large portion of the gallery to be set apart, and put themselves to considerable inconvenience, but ordered the free admission of all persons interested or assisting in the experiments.

* In most of these experiments this distance was reduced to 30 feet, as shown in the "general plan."

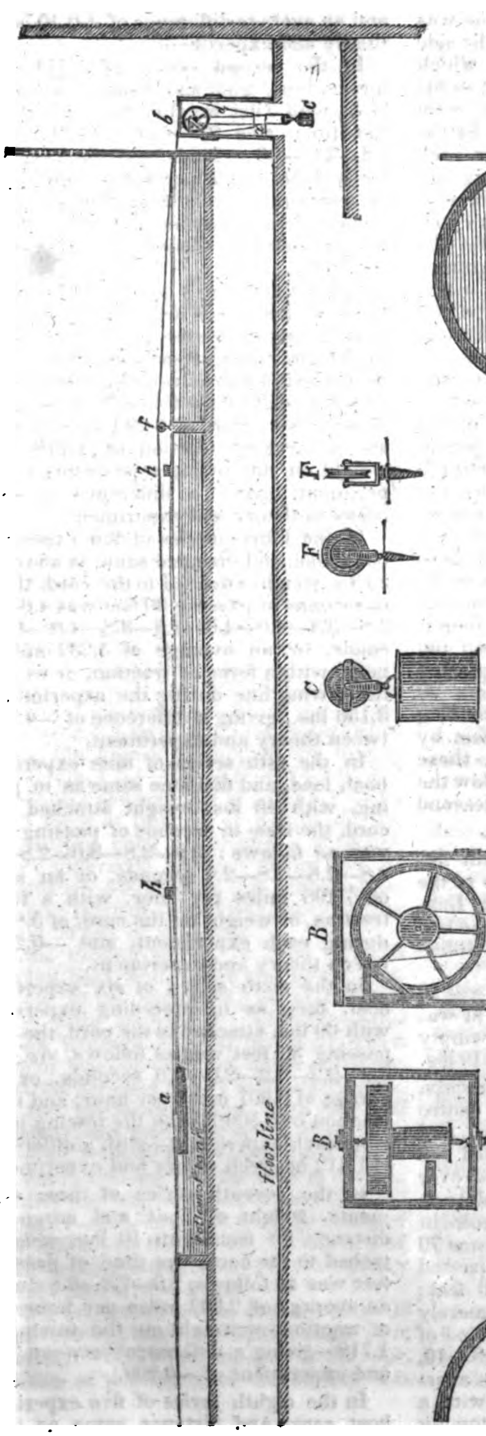
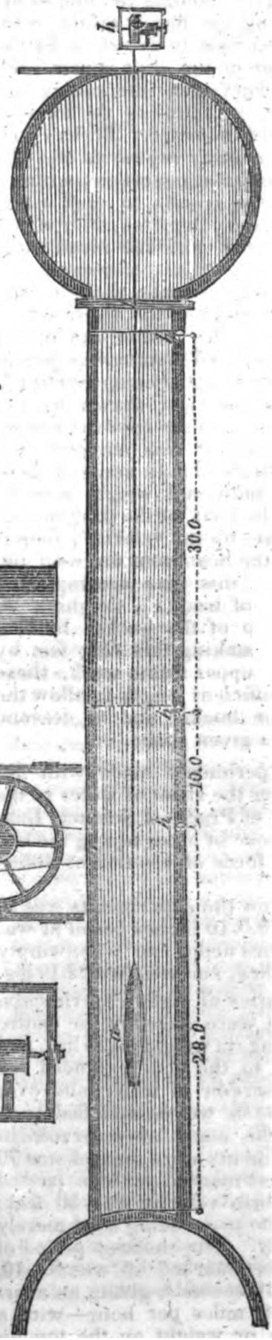


Figure 1.



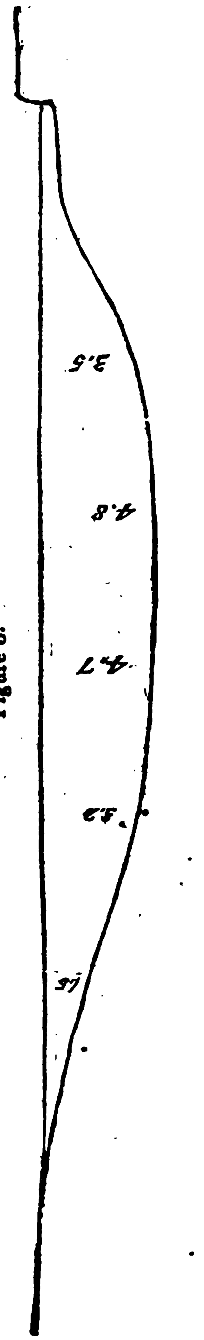


Figure 3.

the bracket at the first wire, and a line was brought from the second wire, along the side of the reservoir, up to the point: by which means, the observer, holding the line in his hand, and keeping his finger on the wire next him, was enabled to ascertain by the touch the passage of the boat under each wire, and the exact time intervening between each wire, by counting the number of beats of the chronometer. These experiments were frequently repeated, and the times noted by different observers, without communicating the results to each other, until each series was completed, after which they were compared, and the mean time taken.

In making the experiments, the line was made fast to the stem of the boat, which was then drawn to the farther end of the reservoir; the required weight was put in the bucket, and on a signal being given, the boat was disengaged, and drawn by the weight in the bucket to the opposite end of the reservoir, where it was stopped by a bag of cork shavings (*f*). In some of these experiments an additional weight was allowed to act on the boat for the first twenty feet, in order to get up the velocity; then it was cut off, and the boat went on with the uniform velocity; this was accomplished by putting a ring of lead (*x*), weighing 20 pounds, on the top of the bucket holding the weights, and making this ring fast by four lines to the upper frame work, these lines being of sufficient length to allow the ring to act on the bucket, and to descend with it, through a given space.

TABLE I.—Experiments made with different models over the sheet of water in the National Gallery of Practical Science, London, for the purpose of ascertaining the law of resistance, or force of traction at different velocities.

The boat used for the experiments was 10 ft. 2 inches long, 8.5-10 inches broad at water level, 3.5 inches deep, and when empty immersed 1.5 inches, and weighed 22.19 lbs.

In the first series of eight experiments, 17.06 lbs. of shot were placed in the centre of the boat, making its weight 39.25 lbs., and a line made fast to the boat, extended the length of the reservoir of water, and over a pulley, with one lb. weight attached to it. The length of the canal or reservoir in which the experiments were formed was 70 feet; but the space marked out to be passed over with a uniform velocity was 30 feet; the first part of the space being used merely to attain headway. The shortest period of passing the 30 feet marked off was 9.4-10, and the longest 10 seconds, giving an average rate of 2.089 miles per hour—with a force of traction or weight on the towing line during each experiment of 0.468 lbs. and an average difference of +0.40 between theory and experiment.

In the second series of eight experiments, boat, load, and distance same as above, with 5 lbs. weight attached to the cord, the time was 7.0—7.0—7.0—7.0—7.20—7.4—7.0—7.0 seconds, and the average velocity 2.802 miles per hour—and the force of traction, or weight on the towing line, during each experiment, 1 lb., with a difference between theory and experiment of —0.102.

In the third series of eleven experiments, the boat, load, and distance same as in the first and second series, with 10 lbs. attached to the cord, time in seconds of passing the 30 feet with uniform velocity was 6.2—6.2—6.0—6.4—6.2—6.2—6.4—6.2—6.0—6.2—6.4—with an average of 3.290 miles per hour, and a force of traction of 1.718 lbs., or weight on the towing rope during each experiment, giving a difference of —0.556 between theory and experiment.

In the fourth series of ten experiments, boat, load, and distance same as above, with 20 lbs. weight attached to the cord, the time in seconds of passing 30 feet was 4.0—4.2—3.8—3.4—4.0—4.0—4.0—3.8—4.0—4.0 seconds, or an average of 5.232 miles per hour, with a force of traction, or weight on the towing line during the experiments, of 3.156 lbs., giving a difference of —0.216 between theory and experiment.

In the fifth series of nine experiments, boat, load, and distance same as in preceding, with 40 lbs. weight attached to the cord, the time in seconds of passing 30 feet was as follows: 2.8—2.8—3.0—2.8—3.0—2.8—2.8—2.8—2.8 seconds, or an average of 7.196 miles per hour, with a force of traction, or weight on the cord, of 5.812 lbs. during each experiment, and —0.251 between theory and experiment.

In the sixth series of six experiments, boat, &c., as in preceding experiments, with 60 lbs. attached to the cord, the time of passing 30 feet was as follows, viz.: 2.2—2.0—2.2—2.2—2.0—2.0 seconds, or an average of 9.607 miles per hour, and force of traction of 8.500 lbs. on the towing line during each experiment—with a difference of +1.412 between theory and experiment.

In the seventh series of three experiments, weight of boat and cargo 53.06, distance 30 feet, with 10 lbs. weight attached to the cord, the time of passing 30 feet was as follows, 7.0—7.2—6.8; making an average of 2.932 miles per hour—force of traction, or weight on the towing line 1.718—giving a difference between theory and experiment of —0.800.

In the eighth series of five experiments, boat, cargo and distance same as in preceding series, with 20 lbs. attached to the

towing line, the time of passing 30 feet was as follows: 5.4—5.2—5.4—5.4—5.2—making an average of 3.845 miles per hour, with a force of traction, or weight on the towing line, of 3.156; making a difference between theory and experiment of —1.568.

In the ninth series of eight experiments, the boat weighing 22.19 without load, the distance passed over, and weight attached to towing line, same as in the preceding, time of passing 30 feet was as follows, viz.: 3.0—3.0—2.9—3.2—3.1—3.2—3.0—3.2—at an average rate of 6.660 miles per hour, with a force of traction, or weight on the towing line during each experiment, of 3.156; making a difference between theory and experiment of + 1.608.

In the tenth series of four experiments, or from the 69th to the 72d, the boat, distance, space, and weight attached to the rope, same as in preceding, the time of passing over 30 feet was as follows, viz.: 3.0—3.0—3.1—3.0—at an average rate of 6.763 per hour, with a force of traction, or weight on the towing line, of 3.156; making a difference between theory and actual experiment of + 1.756. In this series, an additional 10 lbs. weight was added for the first 30 feet of the canal, to bring the boat to her full speed, before reaching the measured space of 30 feet.

In the eleventh series of seven experiments, or 73 to 79 inclusive, the boat, load, and space passed over, same as in the first series, with a weight of 20 lbs. attached to the line, the time of passing 30 feet was as follows, viz.: 3.4—3.6—3.8—3.4—3.6—3.6—3.8—at an average rate of 5.691 per hour, with a force of traction, or weight on the rope, during each experiment, of 3.156, giving a difference between theory and experiment of +0.322. In this series an accelerating force of 10 lbs. was added during the first 20 feet of the canal.

In the twelfth series, or from 80 to 82 inclusive, boat, load, space and power, (except the 10 lbs. additional,) as in the preceding, time as follows: 3.8—4.0—3.6—with an average of 5.392 per hour, and a power of traction of 3.156, and a difference of —0.034 between theory and experiment.

In the thirteenth series, from 83 to 87 inclusive, boat, load, and space, same as in preceding, with 40 lbs. weight, (and 10 lbs. additional to 86 and 87,) the time in passing the thirty feet was as follows, viz.: 2.8—2.7—2.7—2.7—2.7—with an average speed of 7.521 miles per hour, force of traction of 5.812; making a difference between theory and experiment of + 0.263.

In the fourteenth series, or from 88 to 92 inclusive, boat, load, and space, same as in preceding, with 70 lbs. attached to the rope, the time of passing over the 30 feet was 1.9—1.9—1.8—1.6—2.0—with an average rate of 11.180 miles per hour, power of traction 9.863; making a difference between theory and experiment of +3.561.

In the fifteenth series, from 93 to 101 inclusive, boat and space same as in preceding, and in No. 1, with 80 lbs. attached to rope, the time of passing 30 feet was as follows: 1.9—1.8—1.8—1.8—1.8—1.6—1.6—1.6—1.6—or an average of 11.928 miles per hour, and a power of traction of 11.217, and a difference between theory and experiment of 4.063.

[For the subsequent experiments, see next page, where they are given in full as contained in the table, and not, as in the previous descriptions, in a condensed form.]

It will be observed in the above tables, that as the velocity was increased, the power did not require to be increased in any thing like the duplicate ratio, and that the difference shown in the above column, betwixt the theory of the duplicate ratio and the actual experiment, becomes greater as the velocity is increased. I select from these experiments the following as instances. They are not taken from the means, but from the *items* of the experiments themselves.

At a velocity per hour of

2.763	miles,	1.	lb.,	is required,	or	.160	*more*	than the theory of the square.
5.382	"	3.156	"	"	"	.045	"	
5.382	"	3.156	"	"	"	.045	"	
10.765	"	9.863	"	"	"	2.583	*less*	
6.392	"	3.156	"	"	"	1.232	"	
12.784	"	11.217	"	"	"	6.335	"	

I call attention particularly to these individual experiments, in order that the wide deviation may be noticed, and serve to shake the confidence still entertained by the adherents of the old school, who cannot allow that a high velocity is attainable upon canals with economy—not that I consider the old law of the squares to be incorrectly stated. In so far as the boat remains immersed in the water to the same water line, that law may be correct; but that whenever the velocity of the boat is increased beyond a certain point, as will be seen hereafter, the boat emerges a little out of the water, and skims nearer the surface,—the transverse section of immersion being lessened. This will be proved as we proceed.

Such facts being obtained and found to differ so widely from the opinions of philosophers, it was exceedingly desirable that they should not go forth to the public without the fullest confirmation. Happily for science, Colonel Page, Chairman of the Kennett and Avon Canal Company, to whose exertions and liberality it is entirely owing, induced the principal canal compa-

Number of Experiments.	Weight of Boat and Cargo.	Space passed over.	Time.	Miles per hour.	Moving Power.	Force of traction, or weight on the rope.	Force of traction calculated as squares of velocities.	Difference between theory & experiment.	GENERAL REMARKS.
	lbs.	*feet.*	*seconds.*	*miles.*	*lbs.*				
102	39.25	30	3.1	6.598	40	5.812	4.675	—1.137	One weight was placed in the centre of the boat; another weight 18 inches from the centre, abaft; and another 15 inches from the centre, forward.
103	"	"	3.0	6.818	"	"	4.992	—0.820	
104	"	"	2.7	7.575	"	"	6.162	+0.356	
105	"	"	3.6	5.681	20	3.156	3.466	+0.310	
106	"	"	3.8	5.382	20	"	3.111	—0.045	
107	"	"	3.6	5.681	"	"	3.466	—0.310	All the weights placed within 18 inches of the stern.
108	"	"	3.8	5.382	"	"	3.111	—0.045	
109	"	"	3.8	5.382	"	"	3.111	—0.045	
110	"	"	5.6	3.653	"	"	1.433	—1.723	
111	"	"	3.1	5.382	"	"	3.111	—0.045	Weights distributed as in No. 102.
112	"	"	3.8	5.532	"	"	3.111	+0.045	
113	"	"	3.9	5.245	"	"	2.954	—0.202	Weights placed 18 inches from stern.
114	"	"	3.9	5.245	"	"	2.954	—0.202	
115	"	"	2.0	10.227	60	8.500	11.233	+2.733	Weights as in No. 102.
116	"	"	2.0	10.227	60	"	11.233	+2.733	Weights placed 18 inches from stern.
117	"	"	2.0	10.227	60	"	11.233	+2.733	
118	"	"	1.5	13.636	80	11.217	19.970	+8.753	Grahame boat model.—Weight of boat alone 22.19 lbs.; length, 10 feet 2 in.; breadth at water line, 8.5 in.; depth, 3.5 in.; do., immersed when empty, 1.5 in. One weight 24 in. from the stern; a second weight 24 in. more forward; and a third 24 in. still more forward.
119	"	"	1.6	12.784	80	11.217	17.552	+6.335	
120	"	"	1.5	13.636	90	12.619	19.970	+8.351	
121	"	"	1.4	14.610	90	12.619	22.294	+10.305	
122	"	"	1.5	13.636	90	12.619	19.970	+7.351	
123	"	"	1.5	13.636	90	12.619	19.970	+7.351	
124	"	"	1.4	14.610	100	14.021	22.924	+8.903	
125	"	"	3.8	5.532	10	1.718			
126	"	"	4.0	5.113	10	1.718			
127	"	"	3.6	5.681	30	4.359			Bell boat model. Weight 9 lb. 13 oz.
128	"	"	3.0	6.818	50	7.265			
129	"	"	3.2	6.392	50	7.265			
130	"	"	3.6	5.681	50	7.265			
131	"	"	2.6	7.867	10	1.718			Ardrossan boat model. Weight 6 lb. 3 oz. Length 5 feet. Breadth at water line 4 in. Depth 1.5 in. Depth immersed 0.5 in.
132	"	"	2.8	7.305	10	1.718			
133	"	"	2.6	7.867	10	1.718			
134	"	"	1.8	11.363	20	3.156			
135	"	"	1.8	11.363	20	3.156			

nies in England* to subscribe towards paying the expenses of an extended course of experiments with a large boat. I accordingly proceeded to Scotland, and purchased one of the Paisley Canal Company's quick boats, the "Swallow," which we afterwards named the "Grahame and Houston," in compliment to the two gentlemen who have been so eminently successful in improving the canal conveyance of Scotland. Indeed, Mr. Grahame's letters on the subject of canal navigation will furnish the most satisfactory reason why we should have used his name for the boat.

With this boat the results exhibited in the following tables (II. III. IV.) were obtained on the Paddington canal, opposite Holsden Green. The important effects which they are calculated to produce in the minds of the unprejudiced, not only upon inland navigation, but to nautical science in general, have determined me to publish them in the fullest manner, giving every particular connected with their arrangement, as well as the names of those scientific gentlemen who assisted me, together with the names of the assistants from my own office, so that the most ample evidence of accuracy and care may be had: for more advantage will be derived by accurate trains of experiments than will follow from the assumptions of a mathematical century.

The first requisite was a good dynamometer for measuring the tractive force necessary to move the boat at various velocities, and as I showed a marked preference for my own, with which I had obtained such important results during my surveys of roads for the parliamentary commissioners, I shall give a description of it, in order that readers may be satisfied such preference was justly given.

The dynamometer or pirameter, I originally intended for measuring the draught of carriages on turnpike roads, and for this purpose I have used it very extensively under the Parliamentary Commissioners, for the London and Holyhead road, and elsewhere. The following is a description

* The Grand Junction, the Kennett and Avon, the Aire and Calder, the Oxford, and the Leeds and Liverpool.

of the instrument, and in the appendix (B) will be found the opinions of competent judges upon its merits. When I at first endeavored to adapt Marriot's spring weighing machine, so as to ascertain from it the amount of the horse's draught, the stepping motion of the horse created a quick succession of vibrations, which completely prevented any one from reading off the figures indicated—and this confusion of vibrations will always prevent the simple adoption of any species of spring weighing machine. To remedy this inconvenience, and do away with the vibrations as much as was necessary, I applied a piston, working in a cylinder full of oil, and connected with the spring in such a manner that when any power or force is applied to it, so as to make the hand traverse the index, the piston is at the same time moved through the fluid. The connection of the spring and index with the cylinder is by means of a lever working on a pivot: the arms of the lever are of unequal length; the tail-piece of the spring and index is connected with the short arm; at the extremity of the long arm the piston rod is connected; the piston rod, after passing through a stuffing-box in the cap of the cylinder, is screwed into a piston or circular plate of thin brass, perforated with small holes; and out of one part of the circumference a square notch is cut, the use of which will be seen below.

By this construction, the resistance of the fluid to the piston, which acts at the extremity of the long arm of the lever, prevents the sudden jerks of the horse from being marked with those vibrations on the index so much to be avoided; at the same time the piston will move over a space proportioned to the intensity of the force exerted by the horse, and the same will be indicated accordingly upon the dial of the instrument; if the pulls follow each other in rapid succession, the piston will move slowly out, and the hand upon the index will turn round steadily and uniformly, until the power is balanced by the spring.

The dial is graduated in pounds, and decreases from zero upwards, in order to compensate for the increased force which the spring exerts in proportion as it is wound up; in consequence of this the index does not pass over equal spaces when equal forces are applied in different states of tension of the spring: the piston therefore will not pass through equal spaces in the cylinder, and the vibrations would consequently be greater in the higher numbers, because the velocity of the piston being less, the resistance to the piston in passing the fluid will be less, at the same time the power opposed to it is greater. To obviate this, and to make the index equally steady on all parts of the dial, a narrow slip of brass, formed into an inclined plane, is soldered to the inside of the cylinder, parallel to its axis, the largest (or highest) part of this inclined plane being at that end of the cylinder towards which the piston rises when the index moves towards the greater power. The notch which is said above to be cut in the circumference of the plate, (which traverses like a piston in this cylinder,) corresponds in size exactly with the largest part of this inclined plane; so that when the piston is at the upper end of the cylinder, the notch is completely filled up by the inclined plane; on the contrary, when the piston is at the lower end of the cylinder, the aperture is completely opened. By this contrivance the aperture through which the fluid is obliged to pass, as the piston moves from the lower end of the cylinder to the higher, is gradually contracted, and of course the resistance to the passage of the piston through the fluid is gradually increased, and thus compensates the increased power of the spring; rendering the vibrations nearly uniform from the lowest to the highest power. This compensation is similar to that by which the fusee regulates and gives uniform power to the main-spring of a watch.

This instrument* was placed in the doorway of the front cabin, (which is about fourteen feet from the stem of the boat,) and in a line with the ordinary tugging hook; secured with wooden braces and screw nails in such manner as to be perfectly firm and steady, in some instances the towing line was made fast to the weighing bar of the dynamometer, and the power communicated directly to it. In other cases the towing line was made fast to a shackle on an iron lever, the fulcrum of which was the screw bolt which made the bar fast to the gunwale of the boat on the bow nearest the towing path; the power being communicated from the lever to the dynamometer by means of another shackle; this last mentioned shackle being precisely twice the distance from the fulcrum. By this arrangement we were enabled to bring either the whole tractive force to be indicated on the dial plate at once, or only one half that power, as we please, by merely shifting from one position to the other.

I consider this arrangement to be advisable, lest by any chance there should have been an error in the graduation of the dy-

* In the modification of this instrument, which I have now mounted in a light double-bodied phaeton, the dial plate is fitted, not only with an index and hand, but also with a card for determining the bearing; a pendulum which shows, by means of an index and hand, the inclination; a time-piece; and an index and hand to show the distance travelled by the wheels.

namometer. To prove its accuracy, we repeated most of the experiments with and without the lever. If when the power was communicated to the weighing bar of the dynamometer, the instrument indicated the whole traction to be one hundred pounds, and if, when the power was communicated to the other shackle, the instrument indicated only fifty pounds, we were warranted in concluding, that as far as this experiment was concerned, the dynamometer was accurate. Now this I had done on numerous occasions, to prevent the possibility of error; and in order to be more perfectly assured, I repeatedly employed weights, suspended over a pulley, to check the dynamometer.

In making the observations with the dynamometer, every care was taken to have accuracy. Mr. Whitwell kindly assisted me in all these observations. He took the time with an excellent watch, having a detached second hand, with a dead beat, which enabled him to give a signal very accurately at intervals of two seconds. At these signals the power of traction indicated by the dynamometer was read off silently and distinctly by two gentlemen, whose names are at the head of their respective copies. Each of these gentlemen added the observations together, and took the means of each set.

Whilst these observations were making at the fore-sheets of the boat, the times of the boat's passage were noted a little farther aft, by Mr. Turnbull and Mr. Dundas, who had each an excellent chronometer (from Arnold and Dent's.) The word "*time*" was given by Mr. Wilson, when the boat passed the stakes which had previously been driven in the embankment at distances of one hundred yards apart. By this means the observers of the time had never occasion to lift their eyes from the chronometers, except to note down the observations.

Besides the gentlemen making these observations, I was always assisted by others; but more especially by Mr. Alexander Gordon and Mr. Saxton, both of whom being so well qualified, from their practical and scientific acquirements, for such a series of experiments, contributed very materially to prevent errors from taking place, by a general view over each department.

Fig. 3 (see page 87) represents a transverse section of the Paddington canal, opposite the village of Holsden Green; the soundings and measurements having been taken by Mr. Bourns and Mr. Turnbull.

[In the following experiments great care appears to have been taken to ensure accuracy; as the time of passing each stake, placed at 100 yards distance from each other, was marked by two first rate chronometers, and a full account of each is given, both the moment of passing each and the time between the stakes. It is not, however, deemed necessary here to give the separate statements of each time-piece—but merely the *mean* time of passing over the space of 100 yards between each stake, the velocity of passing, the mean force of traction as observed, and the weight of passengers in lbs., &c.]

TABLE II.—*Experiments made with the "Grahame and Houston" Iron Boat, on the Paddington Canal, for the purpose of ascertaining the law of resistance, or force of traction, at different degrees of Velocity. 8th April, 1833.*

No. of Experiments.	Mean time of passing over 100 yards between each Stake.	Velocity in miles per hour.	Mean Force of Traction in lbs., as observed.	Mean Force of Traction, calculated fm. the squares of the Velocities.	Mean Force of Traction, calculated fm. the cubes of the Velocities.	Weight of Passengers in lbs.	OBSERVATIONS.
	"	"					
11	42.25	4.841	75.				Wind ahead, but scarcely perceptible.
12	40.5	5.050	69.87				
13	40.0	5.113	66.50				
14	43.5	4.702	47.26				
15	[illegible]	4.955	61.21	97 90	192.58	2511	
16	37.5	5.454					
17	36.5	5.603	130.46				
18	36.75	5.565	150.11				
19	36.0	5.681	143.77				
20		5.616	141.44	125.94	280.38	2511	
21	29.0	7.053	140.53				
22	28.5	7.177	122.76				
23	27.5	7.437	119.67				
24	26.75	7.646	107.48				
25		7.420	116.63	219.09	646.68	2511	
26	27.0	7.575	170.87				
27	25.5	8.021	140.04				
28	25.0	8.181	136.98				
29	25.0	8.181	144.66				
30		8.127	140.56	262.83	849.71	2511	
31	21.75	9.404	226.98				
32	22.75	8.990	211.58				
33	23.0	8.893	183.40				
34	23.0	8.893	180.21				
35		8.925	191.73	314.80	1135.38	2511	
36	50.37	4.060	50.12				

TABLE II.—CONTINUED.

No. of Experiments.	Mean time of passing over 100 yards between each Stake.	Velocity in miles per hour.	Mean Force of Traction in lbs., as observed.	Mean Force of Traction, calculated fm the squares of the Velocities.	Mean Force of Traction, calculated fm the cubes of the Velocities.	Weight of Passengers in lbs.	OBSERVATIONS.
	"	"					
37	47.37	4.318	49.84				
38	47.5	4.306	42.59				
39	50.25	4.070	43.30				
40							
		4.231	45.24	71.24	119.89	2711	
41	23.0	8.893	235.07				
42	19.0	10.765	281.00				
43	18.0	11.363	303.47				
44	18.0	11.363	278.14				
		11.163	287.53	496.10	2202.02	2711	
45	19.75	10.356					
46	17.5	11.688	309.16				
47	18.5	11.056	311.39				
48	19.5	10.489	261.82				
49		11.077	294.12	488.83	2139.2	2711	
50	96.5	2.119					Tracked by one man.
51	91.0	2.247	23.45				
52	94.25	2.170	33.75				
53	92.25	2.217	23.3				
54		2.211	23.5	19.47	17.01	2711	
55	53.75	3.805					By three men.
56	57.25	3.572	47.28				
57	56.5	3.620	47.18				
58	56.0	3.652	45.04				
59		3.614	46.5	52.03	74.43	2711	
60	24.5	8.349					By two horses.
61	23.5	8.704	174.97				
62	23.25	8.797	193.41				
63	23.25	8.797	174.18				
		8.766	180.85	306.14	1179.74	2711	

In Table II., the first ten experiments are not published, because the arrangements were not, at that time, as perfect as could be wished. The length of the horse line was 82.1 feet; girth, 1.7-8ths; weight, 10 lbs. 1 oz. The length of the light line was 68.1 feet; girth, 7-8ths; weight, 2 lb. 8 oz. The standard adopted for calculating the squares and cubes of the velocities in the experiments mentioned in this table, and all those made on the Paddington Canal, was 2.517 miles per hour.

In Table III., experiments 5, 6, 7, 8, were made by a weight over a pulley; no accurate result. Experiments 13, 14, 15, 16, were also made by a weight over a pulley.

TABLE III.—*Experiments made with the "Grahame and Houston" Iron Boat, on the Paddington Canal, for the purpose of ascertaining the law of resistance, or force of traction, at different degrees of velocity. 9th April, 1833. Fifteen Passengers.*

No. of Experiments.	Mean time of passing over 100 yards between each Stake.	Velocity in miles per hour.	Mean Force of Traction in lbs., as observed.	Mean Force of Traction, calculated fm. the squares of the Velocities.	Mean Force of Traction, calculated fm. the cubes of the Velocities.	Weight of Passengers in lbs.	OBSERVATIONS.
	"	"					
1	73	2.801	29.73			2381	Tracked by one man.
2	77.25	2.647	26.21			Weight the same throughout.	
3	83.5	2.449	25.6				
4	83.25	2.456	23.9				
		2.517	25.24	25.24	25.24		
5	84	2.435	21 lbs.				
6	80.5	2.540					
7	76.5	2.673					
8	79.25	2.580					
		2.597	21	26.87	27.72		
9	68.25	2.977	35				Tracked by two men.
10	68.0	3.008	26.2				
11	63.25	3.233	33.8				
12	64.75	3.158	29.95				
		3.133	29.98	39.10	48.67		
13	67.5	3.030	33 lbs.				
14	69.0	2.964					
15	67.75	3.019					
16	73.25	2.791					
		2.924	30	34.06	39.57		
17	48.5	4.217	59.4				Tracked by two horses.
18	48.0	4.261	56.62				
19	45.5	4.217	62.83				
20	44.0	4 648	65.5				
		4.375	61.65	76.25	132.55		
21	52.0	3.933	58 lbs. too little by 10.				
22	45.5	4.495					
23	43.75	4.675					
24	44.25	4.622					
		4.597					
25	21.5	9.513	267.0				
26	21.25	9.625	238.52				
27	22.0	9.297	228.[illegible]0				
28	21.75	9.404	231.48				
		9.442	232.73	355.18	1338.51		
29	16.5	12.396	436.94				
30	17.0	12.032	395.66?				

TABLE III.—CONTINUED.

No. of Experiments.	Mean time of passing over 100 yards between each Stake.	Velocity in miles per hour.	Mean Force of Traction in lbs., as observed.	Mean Force of Traction, calculated from the squares of the Velocities.	Mean Force of Traction, calculated from the cubes of the Velocities.	Weight of Passengers in lbs.	OBSERVATIONS.
	′	″					One horse employed to track the boat. Boat tracked by two men | Tracked by two horses, large line. |
31	19.5	10.489	300.26				
32	20.0	10.277	270.5				
		10.383	285.15	429.50	1771.93		
33	18.25	11.207	403.6				
34	19.12	10.697	344.8				
35	20.25	10.100	273.0				
36	22.0	9.297	245.75				
37		10.031	287.85	400.87	1597.77		
38	75.5	2.709	27.34				
39	77.5	2.638	25.21				
40	81.0	2.525	22.01				
41	86.0	2.378	22.82				
42		2.513	23.34	25.16	25.12		
43	61.75	3.312	37.35				
44	64.5	3.171	32.36				
45	64.25	3.183	32.23				
46	65.0	3.146	30.15				
47		3.166	31.58	39.93	50.23		
48	17	12.032	350.9				
49	17	12.032	337.75				
50	18.5	11.056	318.3				
51	20.5	9.977	276.55				
52		11.021	310.86	483.90	2119.05	2381	
53	26.25	7.792	189.5				
54	27.	7.575	148.7				
55	26.5	7.718	147.22				
56	26.0	7.867	148.85				
		7.72	148.26	237.44	728.33	..	
57	36.5	5.603	132.84				
58	38.25	5.347	135.26				
59	34.0	6.016	155.41				
60	38.25	5.347	154.52				
61		5.57	148.39	123.60	273.54	..	
62	26.25	7.792	199.07				
63	25.75	7.943	159.65				
64	26.75	7.646	149.2				
65	25.25	8.100	147.62				
		7.896	152.15	248.38	779.28	..	
66	33.75	6.060					
67	35.5	5.761	168.58	139.48	387.93	..	
68	33.5	6.105					
69	34.75	5.886					
70		5.917					

APPENDIX.

A.

Specification of a Light Iron Passage Boat, such as ply on the Summit Level of the Forth and Clyde Canal, between Port Dundas and Windford, and such as was used in the Experiments detailed in the foregoing paper.

Extreme length, 70 feet; do. breadth, 5½ feet. The iron of the very best manufacture. The body plates in particular must be free from rust, cracks, blisters, and roughness of every description. The whole of the iron must be coated with linseed oil, previous to its being used. And the boat must be built under cover, so that the work may be kept dry until the boat is finished.

Although not shown on the plan, the said boat has a hollow keel, so as to prevent the lodgement of water beneath the floor, between the ribs. The stem and stern shall consist of bars of iron, six inches in breadth, and a quarter of an inch thick, which are hammered flat at the lower part to the breadth and thickness of the *keel-plate*, to which they are scarfed and secured with clenched rivets.

As stated above, the keel-plates are formed hollow, and consist of hoop iron, six inches in breadth, and one eighth of an inch in thickness. To which a wood keel of Memel plank, fifty feet in length, nine inches in depth, three inches in thickness next the bottom of the boat, and an inch and a half at the lower edge, tapered off to nothing at each end, must be secured to the keel-plates with glands an inch and a half in breadth, and a quarter of an inch thick, sunk flush into the keel, and screwed inside at the distance of three and a half inches apart.

The ribs shall consist of T and angle iron, and placed alternately at the distance of twelve inches from each other, and extending from gunwale to gunwale; after being bent to suit the curved form of the vessel, two rows of holes are punched on the flat side of the angle and T ribs to secure the body plates, and holes at convenient distances are punched through the upright flange to secure the false ribs for the inside lining.

The body-plates must consist of the best double rolled No. 16 sheet iron, two and a half lb. per superficial foot, and these sheets are in lengths of eight and ten feet. The first range of bottom plates which join the hollow keel, eight feet in length and 24 inches in breadth; the next two ranges on each side which form the bilge, ten feet in length, by twelve inches in breadth; and the range next gunwale, ten feet in length by eighteen inches in breadth. Particular attention is requisite, both with the view to the strength and appearance of the boat, that the whole of the body-plates be run in fair sheer lines

from stem to stern, and that the lower edge of each succeeding length or range of plates cover the upper edge of their accompanying ones, three quarters of an inch, so that the boat in every respect may have the appearance of being clencher built.

The butts, or end joints of the plates, must be kept smooth, and meet on the centre of the T rib, and the joints of each succeeding plate be so shifted as to meet on the T rib nearest the centre of its accompanying ones. It must, however, be expressly understood, that previous to any of the plates being rivetted, a thin stripe of cotton cloth, dipped in white lead paint, be put in between the overlaps of the edge joint, and between the ribs and the end joints, so as to prevent leakage and corrosion. The whole end and edge joints must be secured with countersunk rivets, made from a three-sixteenth of an inch bore, placed at the distance of three fourths of an inch from centre to centre, and made from the best charcoal rivet iron; the rivets, except those for securing the end joints, must be placed two inches distant from each other, and the whole, as stated above, be countersunk, and kept as smooth as possible.

Plates, six inches in breadth, and one eighth of an inch in thickness, to be placed on each side along the bilge, over the body plates, where they are most exposed to injury when taking on board and landing passengers, which will extend from the round of the entry, at the bow, to the commencement of the run or exit at the stern, and are secured to the ribs and body plates with countersunk rivets, placed at the distance of three inches apart; but before they are secured, both the bilge plates and body plates must be properly coated with white lead paint, and a ply of sheathing, dipped in the same, put in between.

One and a quarter inch of angle bars extend from stem to stern, to form the gunwale, to which welts or wood mouldings are secured; and another of the same dimensions to be placed seven inches below the gunwale, to which the wood-belting, three inches thick, and four inches deep round off, is to be secured.

The boat is framed and moulded, and in every respect formed, exactly and agreeably to the plan, and the work must be done in a substantial and workmanlike manner.

Specification of the Carpenter and Joiner Work of such a Light Iron Canal Passage Boat.

The length of the boat as specified, at seventy feet in length, five feet six inches in breadth, and two feet six inches in depth. It is divided in the following manner, viz. Fore deck, 4 feet in length; fore sheets, space for steerage cabin and principal cabin, &c., and after sheets, according to the number of the travellers intended for; after deck, 4 feet.

The false ribs for securing the inside lining consist of willow timber, one inch in breadth, and seven-eighths of an inch in deepness, which must be free from knots and shakes, so that they may bend easily after being stoved to the curved form of the boat, to which they are secured with nails, rivetted to the upright flange of the ribs.

The sea-crofts, fore and aft, must extend from the stem and stern to the end of the cabins, and be four inches in breadth, and two inches in thickness, of best Memel plank, which is kept flush with the gunwale inside, and secured with three-eighths of an inch rivets, one throughout each rib.

Two timber heads on each side, near the bow and stern, are placed in the most convenient situation for mooring the boat, and secured with glands fixed with clenched rivets, so that the timber heads may be taken out and replaced when found necessary; to consist of solid oak timber, five inches in breadth, two inches thick, one foot in length below the gunwale, and seven inches above.

The beams which support the deck fore and aft consist of oak plank two inches thick, three inches deep in the centre, and two inches deep at each end, with a curve of half an inch to the foot in length; and they are secured with a sheet-iron plate to the gunwale, angle iron, and sea-croft.

The gunwale or covering boards should consist of the best Memel fir plank, one inch in thickness, which extends from stem to stem; the cover is secured to the gunwale flange and wele that forms a moulding round the same.

The ends and divisions of the cabins should consist of Memel plank, two and a half inches in breadth, and one and three-fourths inch thick, which will form diagonal frames, for the purpose of strengthening the boat, so as to resist external pressures. The said frames must be lined at the ends of the cabins outside, with the best half-inch American yellow pine plank. The framing in the inside of the cabins may be lined as may be approved of.

The sleepers, for support of the flooring, should be two inches deep, by one and a quarter inch thick, placed and fitted to each alternate rib, and fixed to the upright flange with rivet nails. The flooring should consist of the best yellow pine plank, one inch thick, and not to exceed six inches in breadth, which must be properly cleaned, ploughed, and feathered.

The height of the cabins, from the top of the floor to the lower part of the beams, six

feet at the centre, and the height of the sides above the level of the floor will be five feet under the beams, consequently the beams will have a curve of twelve inches.

The standards or stancheons of the sides of the cabins should consist of the best white American oak, one inch thick, and one and a half broad at the gunwale, and one inch in breadth at the top of the cabin, and placed at each alternate rib, to which it is secured, the distance being twenty-four inches from centre to centre. The top gunwale, for the support of the roof, to be made of the best Memel fir or red pine, free of blemish or knots, and extend the whole length of the cabins, two and a half inches deep outsides; the upper edge is bevelled to suit the curve of the beams, and two inches in thickness, mortised to fit the tenure of the standard, having a projection for a bead, and thickness of outside lining.

The beams, as stated above, to have a curve of twelve inches, to consist of the best clean ash timber, an inch and a half in breadth, by one inch in depth, the lower part rounded to a half-circle, and placed at the distance of two feet from centre to centre, dove-tailed and secured to the gunwale with screw-nails; and a framing of iron wire gauze, well painted, shall be made to connect them, so that the top may form one solid connected form from end to end.

A stringer extends the whole length of the cabins in the centre to support the roof, which is let in, and bound to the diagonal frames, the upper edge kept flush with the top of the curve, consisting of clean solid white Quebec oak timber, three inches in depth, by an inch and a half thick; into which the beams are let nearly in the whole depth, and made exactly for the top covering.

The space outside of the cabin, fore and aft, must be lined from the floor to the gunwale with five-eighths of an inch red pine boards, and seated in the usual form; the tops seven-eighths of an inch thick, with round supports and cross bearers, with two front rails, two and a half inches in breadth, beaded, and let in flush with the bottom and top of the supports or feet.

In order that the boat may be kept as light as possible in the fittings-up, there should be no inside lining of wood from the floor up, consequently the whole seatings in the cabins must have fronts supported with brackets; these brackets to be secured to a stringer, fixed to the sides of the boat the whole lengths of the cabin, three inches in breadth, by an inch and a quarter thick, to which the brackets are let in flush, and nailed to it and the floor. The seats in the principal cabin to be sixteen inches in height, so as to allow cushions two inches thick and eighteen inches in breadth; the back to be one inch lower than the front, which is considered an improvement as a comfortable seat; the seats in the principal cabin may consist of cane, light wood, or lacing, as may be approved of; the fronts consisting of the best American yellow pine five-eighths boards. The seats in the steerage, eighteen inches in height, by fourteen inches in breadth, and fixed with brackets in the same manner as the principal cabin, and be seven-eighths of an inch in thickness.

The outside lining between the gunwale and top of the cabins should consist of the best yellow pine half-inch boards, well seasoned, free of knots, sound, and properly cleaned, ploughed, and feathered. The first board will extend the whole length of the cabins, eight inches in breadth, neatly joined to the covering boards, thin fitters being fitted between the standards or stancheons, and, laid in white-lead paint, so as to be water-tight, is fixed to the side standards with springs.

The space between the standards being twenty-four inches from centre to centre, it is proposed that light windows or patent gauze wire shall be placed in every alternate space, so as the passengers may have a view of the country without being under the necessity of removing to the outside. These windows and frames should be made as light as possible, and made to slide or fold, as may be considered most convenient.

The inside lining, from the seats up, and between the windows, should consist of oil-cloth, fixed and finished with beads and facings.

The top or cover of the cabins to consist of oil-cloth, which must be perfectly water-tight, and fixed to the beams, top gunwales, and ends of the cabin, with a moulding. It will be necessary to have a thin sheet of plate-iron for the funnels, so as to prevent any danger from the heat of the stoves during the winter.

The outside doors should consist of red pine plank, one inch and a quarter thick, bound and pannelled, to be hung with neat light bats and bands, have good five-inch rimmed locks, brass mounted, to open out in two halves, and to have small brass slip bolts at top and bottom. The doors in the divisions to have check locks, and hung with five-inch edge hinges.

The inside doors should consist of the best yellow pine plank, one and one-eighth inch thick, and twenty-two inches in breadth, and finished with facings.

That the whole of the inside, previous to the joiner work being commenced, should have two coats of good lead color paint, and the whole of the iron-work on the outside, as well as the wood-work in the outside and inside, should have three coats of paint of different colors, and finished in a sufficient and workmanlike manner. (*To be continued.*)

PNEUMATIC RAILWAYS.—The following is the communication from Mr. G. RALSTON, on a new, called *Pneumatic*, system of railways, referred to in our last number. It must, we think, be considered as one of the *visions* of the day; yet that is no affair of ours, as we aim to give our readers an account of whatever pertains to the subject of internal improvements, be it ever so visionary—if we imagine that any new idea may be gained from it which will or may benefit the great cause; and it is for the purpose of eliciting discussion that we lay this communication, and the opinion of Dr. Lardner and Faraday,* before our readers.

That the adoption of railroads as the means of inland transit has become a subject of deep interest to the community, and that their vast advantages are duly appreciated, is evinced not only by the ready support which is given by the public to the spirited efforts now making for their extensive application, but also by the sanction which has been accorded them by the Legislature. Indeed, at the present moment, an almost incalculable amount of capital is actually pledged to the institution of a general system of railway throughout the kingdom.

But notwithstanding the admitted advantages of railroads, as at present constructed, worked as they are by the locomotive steam engine, over the old system of transit, that splendid experiment, the Liverpool and Manchester line itself,—to the projectors and managers of which the nation is so greatly indebted for the stimulus it has given to improvements in inland transit and consequent benefit to commerce, the extent of which, indeed, are not yet fully developed,—has at the same time disclosed the inefficiency of the construction by its utter inability to withstand the violent action and tremendous concussions of the ponderous engine, which is also destroyed by its own force, and the imperfections of the locomotive system by the incompetency of the engine to work with advantage except upon a level. Hence the wear and tear of the railways in that line has amounted to not less than £500 per mile per annum, whilst the locomotive engines, of which not less than thirty* are employed upon the road, besides nearly half that number more which come upon it from branch lines, are worked and maintained at the enormous cost of more than £2,000 per annum each.

The immense expenditure of capital required in the formation and construction of the common railroad, owing in a great measure to the necessity of obtaining a nearly perfect level, and the great cost of maintaining and working the ways when they are formed, will necessarily induce the public readily to adopt any improvement which shall have the effect of increasing the *stability of the railway at a diminished cost;* and especially if it combine with it greater *security, efficiency, and economy* in the working.

The invention, which is the basis of the improvement now submitted to the public, consists in the means of applying the elastic and forcing power of the atmosphere, obtained by rarefaction, within a hollow cylinder of from thirty to forty inches in diameter, to carriages and cars *running upon rails on its outer surface;* the action being produced and transferred by means of pneumatic machinery worked by sufficiently powerful fixed or local steam engines.

Steam power, used as a first mover, admits of no application so economical as that by means of fixed engines;† and thus motive power will be obtained at one quarter the expense of that yielded by the locomotive engine. The fixed engine gives also the advantage which the locomotive does not possess, that the intensity of its force can be greatly varied to suit

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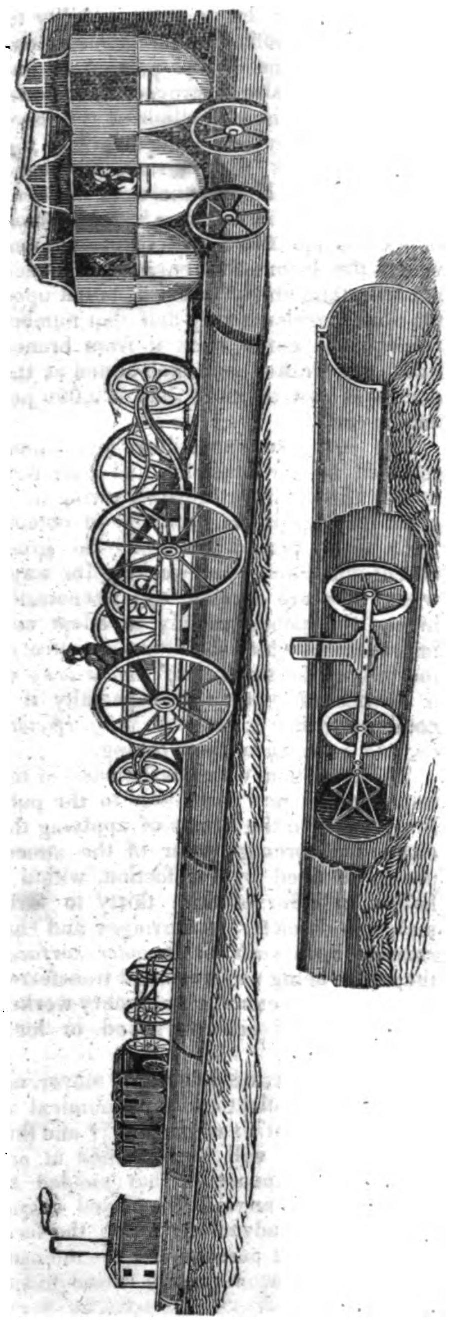
* See p. 8, current volume, of this Magazine.

* This number, at least, is possessed by the Company, though not more than half of them are at any time in working condition; the other half are always in hospital to be repaired.

† A fixed steam engine will last twenty-five years, and the deterioration will not be more than 1½ per cent. per annum.



The first figure represents a Pneumatic Railway in operation, with trains on a double track, approaching each other, one having just passed a stationary engine. N.B. This was designed to represent two trains passing a station, but by mistake the station was misplaced by the engraver.

The second figure represents a sectional view of the railway cylinder, showing the internal arrangement.

the exigencies of the road, and thus it may be rendered available according to the nature of the slope, or steepness of the acclivity to be overcome, the weight to be moved, and the degree of rapidity required. Unlike that of the locomotive engine, the power of the fixed engine is, *by the improved system*, communicated with no indirect expenditure to the load or train of carriages; whilst the power of the locomotive is first applied to bear along its own ponderous bulk, which is of about ten tons weight, or fully one fourth of its usual load, and, as before remarked, it destroys both railway and engine by its violent action and concussive force.

The power of surmounting acclivities renders the most direct lines of communication available, and thus shortens the distances between places, and avoids the necessity of circuitous routes in search of levels. Moreover, the improved system of railway permits of roads being laid through a marsh as well as over a common or down, and with no greater expense, thus affording the means, in many cases, of avoiding the annoyance, inconvenience, and expense, of running roads through parks, and over arable lands. It may be remarked, too, that the great expense involved in the formation and construction of a railroad upon the common system, is totally sunk in cutting down or in tunnelling through hills, and in building across or embanking over valleys; whereas the main expense involved in the formation of a road on the improved system, is in common iron castings, which being almost indestructible, and possessing an intrinsic value, little or no loss can accrue upon them.

Not only does the improved system present a firmer construction of the railway, and a highly economical application of power, but it affords also greater protection to life and property, in the security of the carriages and cars for the conveyance of passengers and goods, since these are so placed upon the rails, and so connected with the railway itself, that they cannot by any possibility be thrown off or overturned. In consequence of this advantage, whatever objection may exist in the public mind to travelling upon railways, because of the danger connected with the common system, will be entirely removed, and a great improvement may

be confidently calculated upon in the important item of passenger traffic.

When it is considered that, *by the improved system, a line of road may be formed and constructed for, at the most, two-thirds, and in some cases for one half, the expense involved by the common system,* and that *such a railway can be maintained and worked with far greater speed, and infinitely greater safety, for three-fourths less than the common system costs,* and that therefore *passengers and goods may be conveyed at one half the price which the common system demands, and then yield a far greater profit,* competition with the Association will be wholly out of the question.

As any degree of speed can be obtained by the improved system, with the most perfect safety, and without the disadvantage, not to say danger, arising from great velocity on the common method, a single line, on the new system, can be made, by the reciprocating plan proposed, to effect as much transit as can be effected by the use of a double line on the former, while the cost will thereby be lessened nearly one half. Hence, communications that may not warrant the expense of a double line of railway, may be advantageously occupied with a single line; numberless lines are in this manner open to the application of the new system, which the common method will not permit of being attempted.

As the invention affords the means of applying the power to the common railway, the proprietors of such must soon be found anxious to avail themselves of its advantages; and thus all the railroads in the country may soon become tributary to the Association, while the interests of the various concerns themselves will be materially improved by the adoption of the improvement.

As many millions are actually invested in this country in canals, and that species of property may be much deteriorated by the general application of railways, unless this improvement which affords them the means of increased speed is adopted by the respective canal proprietaries, the Association may fairly calculate upon rendering all these interests likewise tributary, in exchange for the advantages to be derived from the licence to apply their improved system.

In addition to affording the means of transit upon railways, whether upon the improved or with the common system, the power may in like manner be applied to *effect rapid transit, with great economy,* upon canals.

The practicability of the improvement, and the efficiency of the application, are proved by experimental operation, and confirmed by the opinion of the most eminent scientific men in the kingdom.

The following communication in relation to Pneumatic Railways has been several days in hand. The writer, who had only read the article in our last, will now have seen more in relation to it in this number.

[For the Mechanics' Magazine.]

Mr. Minor,—When will common sense be the order of the day? When shall we again be able to look upon a new scheme as one likely to prove practically useful? This is truly the age of invention and originality; but unfortunately we are still wandering in the green fields of imagination. The *Age of Reason* appears to be yet far distant. But who but a man of *original* mind could have invented either of the three plans which have been lately presented to us through the papers, as marvellously practicable, and calculated to produce a new era in the *moving power* of the world. I refer first to the invention, *by somebody,* (my bump of individuality is too small to enable me to remember all the names connected with these things,) of laying rails on the tow-path of canals, thereby incurring the expense of a road over and above the common expense of a canal, for the purpose of substituting a power upon it which can never be used.

Next comes the invention of Mr. Heron, called a "Water Power Railway:" a scheme which, besides costing at least three times as much as Mr. Heron's estimate for it, is as wanting in practical application as the former.

Lastly comes an invention from over the water, fathered also by an American, and backed by the learning of the Rev. Dion. Lardner, Mr. Faraday, &c. This is the "Pneumatic Railway," whereon we are to be impelled by the "thin air."

This is something philosophical! it is worth reasoning about! It appears that

after the railroad proper is finished, which of course must be as good, if not better, than those made at present, and consequently will cost as much, then the moving power is to be added.

According to the plan of the patentee, this is to consist of a tunnel provided with a piston, to which the cars are to be attached. The tunnel being exhausted of air by means of air pumps, worked by stationary steam engines, the piston, and consequently the cars attached to it, will be impelled by the pressure of the outward air. Suppose, with the patentee, that six stationary engines be placed between Liverpool and Manchester, they will be five miles apart. Now, when but one train of cars can be put in motion at the same time between the engines, and after a train has passed, the five miles of tunnel will have to be re-exhausted before another train can take its place, it appears to me that either more than superhuman power must be exercised in the management of the road, or that there will be very great delay in passing over it. But admitting all this to be arranged, and suppose also that there will be no insurmountable difficulty in laying down and securing the tunnel in so *exact* a manner as it must be, in order to be effective, let us look a little to the *expense* of the project.

I have no information relative to the material which the patentee intends using in the construction of his tunnel, but take it for granted that it must be of cast iron. The quantity of metal contained in a cast iron tunnel 40 inches diameter, in clear, and one inch thick, will be about 401.67 pounds for every lineal foot, or about 946.7 tons per mile.

The whole cost of the tunnel and its appendages may be estimated as follows:

Naked tunnel per mile, 946.7 tons of cast iron, at $80,	$37,868 00
Suppose the above to be cast in lengths of 5 feet; then, allowing the usual quantity of metal at the joints, this item will amount per mile to 140 tons, at $40, . . .	4,160 00
Chairs, 159 tons, at $40, . . .	6,360 00
Stone sleepers, ...	2,500 00
Bolts, spikes, &c., ...	500 00
Workmanship, ...	5,000 00
Total cost for a single track,	$56,388 00
Total cost for a double track,	$112,776 00

To this is to be added the cost of the railroad proper, and the stationary power to work the tunnels—say for the whole $160,000 per mile. A truly economical affair!!

Now, my dear sir, having treated the scheme of others somewhat familiarly, let me exhibit to you a plan of my own, towards which I invite the investigation of scientific men.

I propose making the whole railroad into a tunnel, either by boring the hills, or building upon the surface. Into this a piston must be fitted, to which the cars are to be attached. The *modus operandi* will of course be the same as for Mr. Perkins' tunnel. The difference between Mr. Perkins' and my own scheme is this: Mr. P. first grades his road, and then places his tunnel upon it. It is thereby insecure in the first instance, and liable to derangement ever afterwards; but by my plan, the tunnel and road are one and the same thing. In making the road, the tunnel is made also. Then, as to power, instead of a piston of 9 feet surface, we have one of 144 feet. The stationary engines I propose having outside of the tunnel over the air-shafts.

The expense of a railway of this kind will be about $175,000 per mile, or a little more than one upon Mr. Perkins' plan.

ENGINEER.

June 29, 1835.

[From the Repertory of Patent Inventions.]

Remarks on Lieutenant Rodger's Patent Anchor, with Accounts of Some Experiments, showing its Advantage over Anchors of the Old Construction.

We have, in another part of our journal, given the specification of Lieutenant Rodger's patent for anchors. We have been favored with accounts of a great variety of experiments, together with numerous testimonials, on the result of the practical application of these anchors, which have now made very considerable progress towards coming into general use. On first reading the specification, we were struck with the proposition, that an anchor to be most effective must have the smallest possible flukes, a proposition the very reverse of the theory on which anchors have been constructed for ages.

When we consider the number of lives, and the extent of property which are hourly at stake in various quarters of the globe, and often wholly dependent on the well or ill holding of anchors, we shall be pardoned in taking up some of the pages of our present number with a view to call attention to the present invention, and we cannot perform this important task better than by laying before our readers a few of the experiments. Before we proceed, we are desirous of making some observations on the principles on which the present anchor rests its claims of superiority.

Heretofore it has been universally believed that the holding power of an anchor was in proportion to the size of the palms, than which nothing could be more erroneous; for the fact is, to a certain limit, it is inversely as the size of the palms; and the patentee has availed himself of that size (relative to the length of the arms) which produces the maximum effect, with an anchor of a given weight and length; and which palm is extremely small in comparison with that in general use, (as may be seen on examining the specification.) This reduction of size places at disposal more than one ninth of the whole weight of the anchor, which enables the maker not only to lengthen the shank, which is considered a great desideratum, but at the same time to add to its strength by increasing its dimensions transversely. Were it not for the convenience of fishing the anchor with a hook, in the usual way, the palms might be still further reduced, without materially lessening their power of holding, for even the bare arm, without any palm, is much more effective than the large palm in common use, both as regards taking hold, and retaining it, and that too in soft ground. This may, probably, be considered a bold assertion; but the patentee is fully borne out by the result of more than 250 experiments, which he has made with palms of eighteen different sizes, for an anchor of the same weight; commencing with one half the usual size; and after comparing its power of holding with that of the large palm in common use, by an average of several experiments, made with each alternately, he reduced his improved palm by eighteen gradations, and compared the holding power of each with that of the large palm in the same manner as the first, until at last no palm was left; and strange as it may appear at first, he actually found, that although the arm with the large palm was buried up to the shank in a vessel nearly filled with sand, and covered with water, much less power, applied horizontally, overcame its resistance, and actually pulled it out of the ground, than was required to drag the *bare arm without any palm*. He also found that by increasing the size of the common palm, with the same length of arm, the anchor became less effective than in its present state. The limits of this paper will not admit of a full explanation of these paradoxes; but nevertheless, the above statement, corroborated by the annexed experiments, will receive due credit from every person concerned in nautical improvements. We may briefly state, however, that the inefficiency of the large palm is owing to its loosening the ground, and to its liability to get shod, and its consequent tendency to rise out of the ground; and when this takes place, no dependence can be had on its again taking hold; therefore, another anchor must be let go, when it would otherwise have been desirable to ride by one.

The small palm, on the contrary, does not disturb the ground at the surface; this is to be attributed to its making a more favorable angle with the ground, which gives it a natural tendency to penetrate deeper, until obstructed by the shank, and without the least liability to get shod. This being the case, a ship will seldom, if ever, run away with an anchor with small palms; which, if dragged, will again take hold, with a sufficient scope of cable; for it has no tendency whatever to rise out of the ground. Anchors with small palms are likewise much stronger than those in common use of the same weight, in consequence of the iron heretofore put in the palms, amounting to more than one ninth of the whole, being diffused over the shank and arms; the sectional form of which is also worthy of notice, as uniting a greater amount of strength and flexibility, with a given quantity of material, than is to be obtained by any sectional form in common use; together with the certainty of making the iron of a better quality. It

will likewise be observed, that the shank of the patent small-palmed anchor is longer than usual in proportion to the arms; and from this it derives a double advantage, for it not only makes it easier weighed, but causes it to take immediate hold, and to retain its hold better than an anchor of equal weight, with the same length of arms, and a shorter shank. The small palms likewise greatly facilitate canting the anchor, as they do not touch the ground when the anchor is resting on the crown, and one end of the stock; which, it will be perceived, may be made of one or two pieces of timber; and the anchor may be stocked or unstocked in a few minutes without the assistance of a carpenter, and is, besides, much more secure than on the old plan.

Trials of the Comparative Power of Holding of Lieut. Rodger's Patent Small-Palmed Anchor and an Anchor on the Old Construction, showing the weight of each, and the distances dragged in the different Experiments.

No. of Trials.	Patent Anchor.		Common Anchor.	
	cwt. qr. lb.		cwt. qr. lb.	
	4 0 6		4 0 9	
	Distance dragged.		Distance dragged.	
	ft.	in.	ft.	in.
1st trial, . . .	12	8	32	6
2d do. . . .	21	4	30	0
Sum,	34	0	62	6

Place of Trial, and Remarks.—On the sand on the south shore, a little below Messrs. Hawks & Co.'s Manufactory, at Gateshead. The power consisted of two treble blocks and rope fall, with 16 men on each end of the fall. During part of the 2d trial, a weight equal to 1 cwt. 2 qrs. 11 lbs. was placed on the shank (in a line with the points) of the common anchor. The ground consisted of clean sand.

Gateshead, Nov. 28, 1833.

No. of Trials.	ft.	in.	ft.	in.
1st trial, . . .	9	0	39	0
2d do. . . .	8	0	47	0
Sum,	17	0	86	0

Place of Trial, and Remarks.—On the Coble Landing, South Shields. The purchase as above, with 20 men on each end of the fall. The ground consisted of a mixture of sand and clay.

South Shields, Dec. 3, 1833.

No. of Trials.	ft.	in.	ft.	in.
1st trial, . . .	5	3	59	0
2d do. . . .	7	0	45	0
Sum,	12	3	104	0

Place of Trial, and Remarks.—On the Coble Landing, South Shields. The purchase, &c., as above.

South Shields, Dec. 5, 1833.

No. of Trials.	ft.	in.	ft.	in.
1st trial, . . .	12	0	51	0
2d do. . . .	7	6	54	0
3d do. . . .	5	0	51	0
Sum,	24	6	156	0

Place of Trial, and Remarks.—At the back of Sunderland South Pier. The purchase as at South Shields. The ground consisted of a mixture of sand and gravel.

Sunderland, Dec. 12, 1833.

In all the above experiments the anchors were placed on a level, (between the high and low water marks,) about 60 feet apart, and drawn together by means of a tackle. After the first trial the anchors were reversed and tried again; and it was observed that the difference was greatest when the patent anchor was in firm ground.

Trials of the Comparative Power of Holding of Lieut. Rodger's Patent Kedge Anchor without Palms, and Kedges on the Old Construction; showing the weight of each, and the distances dragged in two Series of Experiments. The first upon the sand on the south shore, Gateshead; and the second upon the Coble Landing, South Shields.

First Series.	Patent Kedge.			Dist. drag'd.		Common Kedge.			Dist. drag'd.	
	c.	q.	lb.	ft.	in.	c.	q.	lb.	ft.	in.
1st and 2d trials,	1	0	0	43	0	1	0	5	105	0
3d and 4th do.	1	0	0	48	0	1	2	1	89	0
5th and 6th do.	1	0	0	72	0	1	3	24	56	6
Sums,	3	0	0	163	0	4	2	2	250	6
Means,	1	0	0	54	4	1	2	0⅔	83	6

July 8, 1834.

Second Series.	Patent Kedge.			Dist. drag'd.		Common Kedge.			Dist. drag'd.	
	c.	q.	lb.	ft.	in.	c.	q.	lb.	ft.	in.
1st and 2d trials,	1	0	0	38	6	1	0	5	93	6
3d and 4th do.	1	0	0	36	0	1	2	1	100	6
5th and 6th do.	1	0	0	77	0	1	3	24	59	9
Sums,	3	0	0	151	6	4	2	2	253	9
Means,	1	0	0	50	6	1	2	0⅔	84	7

July 9, 1834.

The ground consisted of clean sand, on which the kedges were placed on a level, (between the high and low water marks,) about 80 feet apart, and drawn together by means of a tackle composed of two double blocks and a chain fall, with 26 men on each end of the fall. And each kedge, after its first trial, was reversed and tried again.

The ground consisted of sand and clay, on which the kedges were placed as above, and drawn together by means of 20 men on each end of the fall.

By the above statements it will be seen, that in the 1st series of experiments the patent kedge of 1 cwt. was dragged 163 feet, and the common kedges of 1 cwt. 0 qrs. 5 lbs., 1 cwt. 2 qrs. 1 lb., and 1 cwt. 3 qrs. 24 lbs., were dragged 250 feet 6 inches; and if the means of the weights and distance be taken, we shall have—Patent kedge, of 1 cwt., dragged 54 feet 4 inches; common kedge, of 1 cwt. 2 qrs. 0¾ lb., dragged 83 feet 6 inches; which is in the ratio of rather more than 3 to 2.

In the 2d series the mean is: Patent kedge, of 1 cwt., dragged 50 feet 6 inches; common kedge, of 1 cwt. 2 qrs. 0¾ lb., dragged 84 feet 7 inches; which is in a still higher ratio than the former, although the weight of the common kedge was one half greater than that of the patent.

And there can be no doubt, that had the ground been harder, or of a more adhesive quality, the result of the experiments would have been still more favorable to the new plan. In addition to the few observations with which we have thought it desirable to preface this subject, in thus laying before our readers the various results of the experiments above given, we should not be doing full justice to the patentee if we were to close our notice without stating that we have a very large packet of communications from captains and pilots of vessels, who have tried the patent anchors under every circumstance of weather and anchorage. We have also copies of votes come to, in favor of the new anchors, by general meetings of the Nautical Assurance and other companies of South Shields, strongly recommending the patent anchors.

The Book of Science, adapted to the comprehension of Young People.

MECHANICS.

There is perhaps no department of Natural Philosophy of such extensive importance as Mechanics, since its principles are founded on those properties of matter which are among the most obvious and essential,—namely, Mobility and Weight; and the effects produced by the operation of these properties are so distinct and certain, that they can be subjected to mathematical calculation. Hence Dr. Wallis has described Mechanics, with some degree of propriety, as the "Geometry of Motion." —The designation of this branch of knowledge, like most other scientific terms, is derived from the Greek: the word *Mechane*, signifying a *Machine*; and Mechanics may be considered as the Philosophy of Machinery, or the Theory of Moving Powers. Many writers have treated of this science under two heads, regarding those principles which relate to the gravity or weight and to the equilibrium of bodies, or the powers which preserve bodies in the state of rest, as the subject of the doctrine of Statics;* and the principles relating to the causes of movement, or the forces producing motion, acting by means of solids, as forming the subject of the doctrine of Dynamics.† But, as the respective states of bodies at rest and bodies in motion may be most correctly considered as the consequences of different modes of action of the same causes, they may be instructively illustrated by showing their relations to each other, for which reason it will be proper to treat of them in conjunction, rather than separately.

From this statement of the nature and objects of Mechanics, it will at once appear that we have by no means overrated the importance of an acquaintance with this science to the Student of Natural Philosophy. For all motions are more or less subjects to the laws of Mechanics, and without a knowledge of those laws, it is impossible to appreciate the effects or calculate the consequences of those motions of the celestial bodies which occasion the phenomena of Astronomy; or of those properties of fluids, whether liquid or gaseous, on which depend the principles of Pneumatics, Hydrostatics, and Hydraulics; or indeed of any circumstances affecting the ponderable forms of matter. And those sciences which relate to heat, light, electro-magnetism, vital power, either in animals or vegetables, or any other phenomena which appear to be independent of the force of gravitation, yet derive most important aid from Mechanics; for it is chiefly by means of mechanical instruments that the influence of heat, light, electricity, magnetism, or the effects of vitality, as in the motion of the blood in animals, or of the sap or other fluids in vegetables, can be estimated. Mechanics may therefore be considered as the basis or groundwork of the other Physical Sciences, or branches of Natural Philosophy.

Previously to entering on the consideration of the Theory of Mechanical Powers,

* From the Greek verb *Stao*, to stand, or be fixed; or from *Stesis*, the act of standing.

† From the Greek word *Dunamis*, power, or force.

it will be necessary to show the nature and effects of mobility, or the capacity for motion, and of weight, or the gravitation of bodies,—as these are the general properties of matter on which, as already stated, the phenomena of Mechanics depend.

Mobility.

Every individual body, or portion of matter, must take up a certain space. This may be considered as the absolute place of the body, in reference to its situation simply and singly; or as its relative place, or situation with respect to other bodies. The relative situation of a body may be changed either by its own motion, or by the motion of the bodies around it. A body may exhibit the appearance of actual motion, or absolute change of place, while it remains at rest, its change of place being only relative. Thus, the moon, when a train of thin fleecy clouds is passing over its face, if we attentively fix our eyes on it, seems to move, and the clouds to stand still, though this is only an apparent motion of the moon, in a direction contrary to that in which the clouds are really moving. And if we hold a common eye-glass, or any transparent substance, a few inches before the eyes, and move it backwards and forwards, looking through it at any object, as an inkstand or knife, which remains unmoved, it will, as in the former case, exhibit an apparent motion, arising from the actual movement of the glass.

Mobility is the capacity of a body for change of place by its own motion; it therefore infers the capability of real or actual motion, and not of relative motion only. Yet this change of place may sometimes be most readily estimated by the consequent relative motion which accompanies it. Thus, a person sailing in a boat on a smooth stream, or going swiftly in a coach along an even road, would hardly perceive the motion of the vehicle except by the change of scene, and trees or buildings on the banks of the stream, or by the roadside, would seem to move in an opposite direction from that of the real motion of the boat or carriage. Every tolerably well informed person now admits that the earth moves, and the sun stands still; but the motion of the former is not perceptible, and the apparent daily motion of the latter, being so obvious to our senses, was, till within the last three centuries, considered as a real motion, the existence of which could not even be questioned with impunity.

Without some active cause motion can neither commence nor cease; since a body in the state of rest would always remain unmoved, if never subjected to the influence of a moving force, and, on the contrary, a body when set in motion would go on to move for ever, if it met with no opposition to its progress. It may seem inconsistent with this doctrine that any body set in motion, within the range of our observation, will continue to move without a fresh impulse for a time, but at length will slacken its speed, and finally resume the state of rest. Thus, a cannon-ball will pass a certain distance when discharged from the mouth of a cannon, but if it does not strike a solid body, still it will ultimately fall to the ground; and a marble or a cricket-ball thrown forwards with the hand, if it meet no obstacle, will reach only a certain distance, proportioned to the force used in throwing it. In both these and all similar cases, the termination of the motion of the moving body is owing chiefly to two causes. The first of these is gravitation towards the earth's centre, common to all bodies, and which constantly tends to keep them at rest, pressing on the surface of the earth with a degree of force proportioned to their weight and bulk; or, if, as in the case of the cannon-ball, they pass through the air, the force of gravitation then tends to draw them continually nearer to the earth, till at length they fall and rest upon it. But the second and more obvious cause of the decay of motion is the resistance of the medium through which the moving body takes its course; and thus, a body moving through the air, like the cannon-ball, gradually becomes less and less able to pass forward till its moving force is destroyed. It will be readily perceived that the resistance of the medium to the body which passes through it must depend much on its density or consistence; thus, a ball driven by a certain force would pass farther through the air than through water, and farther through the latter than through a denser fluid, as brine or syrup, or through solids, as sand or clay. Another circumstance which will affect the motion of a body, with relation to the medium through which it travels, must be taken into the account, and this is the form of the moving body. A small body will meet with less resistance than a large one of the same weight; and a body which presents an extensive surface to the medium through which it moves, will be retarded in its passage much more than one with a small surface. A sheet of paper stretched out to its full extent, and suffered to fall a few feet, and then folded up into a small compass, and again suffered to fall from the same height, will afford an exemplification of the resistance of the atmosphere to falling bodies; and an illustration of a different kind, but to the same purpose, may be drawn from the advantage which sharp-edged and pointed instru-

ments have over blunt ones in penetrating hard or tough substances. A body moving in contact with a solid substance, as when it is rolled or dragged along the ground, is also affected by friction. This obstacle to motion is proportioned to the roughness or smoothness of the surface over which the body passes: thus, a marble thrown with any given force will run much farther along an even pavement, than along an equally level gravel walk; and still farther along smooth ice. Here again the form of the moving body has much influence on the velocity and extent of motion; for the fewer the points of contact between the surface and that which passes over it, the more freely will motion take place.

All bodies subject to our control are exposed to the operation of gravity, in various degrees, and from this cause, independent of the resistance of the medium which they traverse, or of the effect of friction, their motions cannot be indefinitely continued, but must decline and terminate in a given time, according to the circumstances in which they are placed. But though perpetual motion cannot be exhibited by any methods which human skill or industry can contrive, yet we have continually before us the display of bodies which have been moving with undiminished velocity for ages past, and which no power but that which governs all nature can prevent from moving in the same manner for innumerable ages to come. The bodies to which we refer, as will probably be anticipated, are those whose motions are the objects of the science of Astronomy; and though that subject will not come under our immediate discussion, yet the general nature of the forces which occasion the revolution of the celestial bodies will be explained, and the causes of their uniform and uninterrupted motion will be illustrated.

That state of bodies just described, in which motion or the cessation of motion can take place only in consequence of an extraneous cause, has been termed Inertia, which signifies inactivity, equally opposed to motion when at rest, and to rest when in motion; so that, if a given force is required to make a body move with a certain velocity, the same force will be required to destroy its motion. When a garden roller is being drawn along a level grass-plot, the exertion necessary to stop it suddenly, at any given point, would be precisely the same as would be required to move it backward, if it were at rest, and of course the same that was applied to set it in motion at first.

Any force applied to produce motion may be called Power, or impulse, which may be either continued, as in the case of pressure, or intermitting, as in the case of impact or percussion. Whatever opposes motion so as to retard the moving body, destroy its motion, or drive it in a contrary direction, may be termed Resistance, and its effect, re-action or counteraction. It is one of the laws of motion that action and re-action are always equal and contrary. Thus, in pressing down the empty scale of a balance, while the other scale held a five-pound weight, it is obvious that the force exerted must be equal to five pounds; but if one scale had been loaded with fifteen pounds, and the other with only ten, the equilibrium might still be preserved by pressing on the latter with a force equal to five pounds only. And if a man, sitting in a boat on a canal, draws towards him, by means of a rope, another boat of equal weight, they will meet at a point half-way from the places whence they began to move. Suppose, however, the second boat to be so laden as to be twice the weight of the first, it must move the slower of the two, and consequently the point of meeting would be nearer the second boat than the first. If a body in motion strikes another body of equal mass at rest, the two bodies will move together, but with only one half the original velocity of the first, the other half having been expended in overcoming the inertia of the second body. Corresponding effects will take place, whatever difference there may be between the masses of the two bodies; for if the second body should be double the mass of the first body, the common velocity after the impact of the two bodies would be one-third that of the first; and if the mass of the first body be to that of the second as 5 to 7, the common mass after impact will be 12, and as the second will deduct from the motion of the first in proportion to its mass, the motion lost by the first body will be seven-twelfths, and the motion retained would be five-twelfths. If two bodies are both in motion in the same direction, and one overtake and impinge on the other, suppose the masses of the two bodies to be the same, and the velocity of the first to be 7, and that of the second to be 5, their common velocity after impact will be 6, or half the sum of the two velocities. But if the masses are unequal, the mass of each must be multiplied separately by its velocity, and the products added together, and their sum divided by the sum of the two masses will give the common velocity. When two bodies are moving in opposite directions, with the same velocity, and having equal masses, action and re-action being equal, both motions will be destroyed. Suppose, however, the masses to be alike, and the velocity of the first body to be 10, and that of the other to be 6, the first body will lose 6 parts of its ve-

locity, which will be requisite to neutralize or destroy the opposite velocity of the second body, and the remaining 4 parts of the velocity of the first body being divided between the two, they will move together in the direction taken by the first body with a common velocity equal to 2. When the masses, as well as the velocities, are unequal, the common velocity of two bodies after impact may be found by multiplying the numbers denoting the masses by those expressing the velocities respectively, subtracting the lesser product from the greater, and dividing the remainder by the sum of the numbers denoting the masses: the quotient will then show the velocity with which the bodies will move together, in the direction of the body having the greatest quantity of motion.

[For what follows see page 35, of the Apprentice's Companion, "Equality of Action and Re-action in the Collision of Bodies."]

[From the Springfield, Mass. Gazette.]

Temperance Anecdote, *illustrating the happy influence of a single Tract or Tale upon a whole village.*—A gentleman, not a great while since, in passing through a small village, when on a journey, met with a slight accident to his carriage, which detained him there some time in getting it repaired. While there, he entered the lowly habitation of one of the villagers, the occupant of which was an intelligent woman, who was a widow. After conversing some time on various subjects, her own domestic circumstances being alluded to, she said that her family had once been wretched in the extreme; and intimated to the stranger, in a feeling and delicate manner, that her husband contracted in early life habits of intemperance, and died under their influence—that her son, her *only* son, followed in the footsteps of his father, and became a sot.

After the death of her husband, a friend at a distance had sent her a little book; after reading it herself with intense interest, she induced her son and several other individuals in the village to read it also. Her son soon after became a reformed man, and has continued so ever since. Such was the case also with others who read it. A temperance society was soon formed, to which a multitude of all classes promptly joined themselves, and this little village experienced an entire moral renovation, through the influence of this single book.

On being inquired of by the stranger, what the little book was that produced such happy effects, she said she had kept it very choice in her desk—"for," said she, "next to my Bible, I prize it above all other books." She soon produced it, and taking off the paper in which it was enveloped, presented it to the stranger, who immediately recognized it as a familiar friend. It was "My Mother's Gold Ring," and the stranger who then held it was Lucius M. Sargent, *the author.* What emotions of delight must have filled the bosom of Mr. S. on this occasion! Who would not value such feelings infinitely more than all the unhallowed gains that were ever realized from the traffic in ardent spirit?

Before leaving the cottage of the widow, Mr. Sargent presented her with the entire series of his Temperance Tales.

The above anecdote we received from such a source, that it may be relied upon as substantially correct.

Could we imagine that such important results would attend the reading of a whole volume of *this* work, we should feel amply compensated for all our exertions to give it an extensive circulation.—[Ed. A. C.]

India Rubber.—Although so many establishments are in active operation for the manufacture of India rubber, such is the manifest utility of the articles made of it, and such the demand for them by the most intelligent people, that it may be safely said that the whole business is still in its infancy. It is a curious circumstance in the recent history of this novel fabric, that those countries from whence the raw material is drawn, without the least question, must ultimately become the greatest market for India rubber goods in the world. Indeed, tropical climates, of all others, require the clothes and casings which none but New-Englanders seem to understand how to make. The rainy seasons of equatorial regions have been regarded with perfect dread, on account of the utter impossibility of venturing beyond the threshold, without being instantly drenched under those torrents of rain which appear to fall directly from the windows of heaven, and from which no other kind of covering could shield the body. Since the discovery of India rubber cloth, the entire aspect of those deluged countries will be changed. Men may now go abroad for the transaction of business, fearless, though the rains descend in torrents, perfectly comfortable, under the protection of garments so light that the freedom of the body suffers no restraint. One great obstacle to the active operation of armies in the tropical countries has been the periodical rains, destructive alike to soldiers and military armaments. A simple India rubber watch coat and cap completely shuts out the storm, so

that nothing short of a flooding of the land could impede the march of soldiery, dressed in these beautifully devised habiliments.

But without all these boundless avenues for the consumption of manufactured India rubber, our own country alone, before the completion of two years more, cannot be supplied by the united labors of all the manufactories of Boston and its vicinity; hence the value of the corporate property must be constantly increasing; for new conveniences, and unlooked-for contrivances, indispensable even in domestic life, as well as in the useful arts and sciences, are daily being discovered, and which can only be constructed economically from this singular elastic gum. Viewing the progress of discovery, as it especially regards this one article, our admiration is raised, and our wonder excited, by the ingenuity and skill displayed in the various adaptations of India rubber to the daily, and even hourly wants of mankind.—[Scientific Tracts.]

Salt of Caubul.—Mr. Elphinstone, an observing traveller in the kingdom of Caubul, in Persia, says, at Callabaugh, the river Indus is so compressed between mountains, that at that particular place it it is only three hundred and fifty yards wide. On each side, the mountains are so abrupt in their descent towards the water, that a road has been cut along the base on one side, upwards of two miles. A little beyond this terrifying pass, the road is excavated out of solid mineral salt. Cliffs of salt, hard and clear like crystal, occasionally tinged with streaks of red, overhang this astonishing highway, more than a hundred feet high. Salt springs are frequently seen, bubbling up salt water, which, crystallizing in the sun, leaves the surface, in the neighborhood of the springs, frosted with crystals of the most dazzling brilliancy. Near the town the soil is almost of a blood red color, which, together with the strange yet beautiful spectacle of the salt rock, and the majestic Indus flowing through the serpentine channel of the mountains, constitutes a scene of indescribable wonder and thrilling astonishment.—[Ib.]

[From the London Penny Magazine.]

As an antidote against *all* intemperance, whether of the rich or the poor, we print an impressive paper, descriptive indeed of an imaginary case, but possessing all the force of truth. It is understood to be from the pen of the late Mr. Lamb.

CONFESSIONS OF A DRUNKARD.

"Could the youth to whom the flavor of his first wine is delicious as the opening scenes of life, or the entering upon some newly-discovered paradise, look into my desolation, and be made to understand what a dreary thing it is when a man shall feel himself going down a precipice with open eyes and a passive will—to see his destruction, and have no power to stop it, and yet to feel it all the way emanating from himself; to perceive all goodness emptied out of him, and yet not to be able to forget a time when it was otherwise; to bear about the piteous spectacle of his own self-ruins: could he see my fevered eye,—feverish with last night's drinking, and feverishly looking for this night's repetition of the folly; could he feel the body of the death out of which I cry hourly with feebler and feebler outcry to be delivered,—it were enough to make him dash the sparkling beverage to the earth in all the pride of its mantling temptation.

O! if a wish could transport me back to those days of youth when a draught from the next clear spring could slake any heats which summer suns and youthful exercise had power to stir up in the blood, how gladly would I return to thee, pure element, the drink of children, and of child-like holy hermits! In my dreams, I can sometimes fancy thy cool refreshment purling over my burning tongue. But my waking stomach rejects it. That which refreshes innocence only makes me sick and faint.

But is there no middle way betwixt total abstinence and the excess which kills you? For your sake, reader, and that you may never attain to my experience, with pain I must utter the dreadful truth, that there is none, none that I can find. In my stage of habit, (I speak not of habits less confirmed, for some of them I believe the advice to be most prudential,) in the stage to which I have reached, to stop short of that measure which is sufficient to draw on torpor and sleep,—the benumbing apoplectic sleep of the drunkard,—is to have taken none at all. The pain of the self-denial is all one. And what that is I had rather the reader should believe on my credit than know from his own trial. He will come to know it whenever he shall arrive at that state in which, paradoxical as it may appear, *reason shall only visit him through intoxication:* for it is a fearful truth, that the intellectual faculties, by repeated acts of intemperance, may be driven from their orderly sphere of action, their clear day-light ministeries, until they shall be brought at last to depend for the faint manifestation of their departing energies upon the returning periods of the fatal madness to which they owe their devastation. The drinking man is never less himself than

during his sober intervals. Evil is so far his good.

Behold me, then, in the robust period of life, reduced to imbecility and decay. Hear me count my gains, and the profits which I have derived from the midnight cup.

Twelve years ago I was possessed of a healthy frame of mind and body. I was never strong, but I think my constitution, for a weak one, was as happily exempt from the tendency to any malady as it was possible to be. I scarcely knew what it was to ail any thing. Now, except when I am loosing myself in a sea of drink, I am never free from those uneasy sensations in head and stomach which are so much worse to bear than any definite pains and aches.

At that time I was seldom in bed after six in the morning, summer and winter. I awoke refreshed, and seldom without some merry thoughts in my head, or some piece of a song to welcome the new-born day. Now, the first feeling which besets me, after stretching out the hours of recumbence to their last possible extent, is a forecast of the wearisome day that lies before me, with a secret wish that I could have lain on still or never awaked.

Life itself, my waking life, has much of the confusion, the trouble, and obscure perplexity of an ill dream. In the day-time I stumble upon dark mountains.

Business, which, though never particularly adapted to my nature, yet as something of necessity to be gone through, and therefore best undertaken with cheerfulness, I used to enter upon with some degree of alacrity, now wearies, affrights, perplexes me. I fancy all sorts of discouragements, and am ready to give up an occupation which gives me bread from a harassing conceit of incapacity. The slightest commission given me by a friend, or any small duty which I have to perform for myself, as giving orders to a tradesman, &c., haunts me as a labor impossible to be got through. So much the springs of action are broken.

The same cowardice attends me in all my intercourse with mankind. I dare not promise that a friend's honor, or his cause, would be safe in my keeping if I were put to the expense of any manly resolution in defending it. So much the springs of moral action are deadened within me.

My favorite occupations in times past now cease to entertain. I can do nothing readily. Application, for ever so short a time, kills me. This poor abstract of my condition was penned at long intervals, with scarcely any attempt at connexion of thought, which is now difficult to me.

The noble passages which formerly delighted me in history, or poetic fiction, now only draw a few weak tears allied to dotage. My broken and dispirited nature seems to sink before any thing great and admirable.

I perpetually catch myself in *tears*, for any cause or none. It is inexpressible how much this infirmity adds to sense of shame, and a general feeling of deterioration.

These are some of the instances concerning which I may say with truth that it was not always so with me.

Shall I lift up the veil of my weakness any further, or is this disclosure sufficient?"

[From the same.]

MINERAL KINGDOM. *Gold.*—This metal possesses above all others the qualities of utility and beauty, without any deleterious property. It has been in all times regarded as the most perfect and most precious of the metals, and among the more civilized nations has been the standard of value for other commodities. Its peculiar rich hue is well known; and it is the only metal of a yellow color. In its pure state it is as soft as tin, and is very flexible, but it is capable of receiving a high lustre by polishing with a burnisher, although inferior in brilliancy to steel, silver, and mercury. It possesses little elasticity or sonorousness. Its specific gravity is 19·30—that is, it is more than nineteen times heavier than water, bulk for bulk. In *malleability* it exceeds all other metals; for one grain of it can be beat out into a leaf so thin as not to exceed $\frac{1}{280000}$th part of an inch in thickness, and which will cover fifty-six square inches; in this state, notwithstanding the high specific gravity, it will float in the air like a feather. But even that is not the extreme limit to which it is capable of being extended; for a coating of gold, which is calculated to be only one-twelfth part of the above thickness, is produced by another process: if a silver wire be covered with gold, it may be drawn out into wire of still greater fineness, and retain a coating of gold; and one grain of gold will in this way coat a surface of wire about two miles and three-quarters in length. In *ductility* it also exceeds all other metals; that is, it can be drawn into finer wire than any other. In *tenacity*, however, it is greatly inferior, standing only fifth in order, in respect of that property when compared with other metals: a wire $\frac{1}{13}$th of an inch in thickness will not support a greater weight than 150 lbs., whereas iron wire of the same diameter will sustain a weight of 550 lbs. without breaking. It is not a perfectly opake body like all the other metals, for gold leaf transmits a green light; as may be conveniently

observed by laying a leaf between two thin plates of colorless glass, and holding it between the eye and a strong light. It is less fusible than silver, and more so than copper: Mr. Daniel estimates its melting point to be at a heat equal to 2016° of Fahrenheit's scale. It is the most perfect of all conductors of heat; that is to say, if heat be applied to one end of a rod of gold, it will be transmitted from particle to particle, and become sensible at the other extremity of the rod more quickly than through any other substance in nature. Thus while the conducting power of a rod of porcelain is represented by a velocity of 12, of lead by 179, of iron by 374, the velocity of gold is 1000. Gold may be exposed for ages to air and moisture without undergoing any alteration; and a quantity of it has been kept for thirty weeks in a melted state in a glass-house furnace without the loss of a single grain, and without any change in its nature. But if a small portion of it be intensely heated by electricity, or by the oxy-hydrogen blow-pipe, it burns with a greenish blue flame, and is dissipated in the form of a purple powder.

Gold is found, almost universally, in the native or metallic state; but it is seldom quite pure, being generally alloyed, in greater or less degree, with other metals, and usually with silver, copper, or iron. The Prussian chemist, Klaproth, found a native gold from the Altai Mountains to contain as much as 36 per cent. of silver; and Professor G. Rose, of Berlin, by more recent analysis, has found a specimen from the same district to contain 38 per cent., and another from Hungary nearly 39 per cent. He found the gold of the Ural Mountains to contain from 2 to 15 per cent. in general; but one variety so free from foreign admixture as to contain nearly 99 per cent. of pure gold. Boussaingault has found the native gold of Colombia to contain from 2 to 36 per cent. of silver. It is found in veins in the primary and older sedimentary rocks, and also in the unstratified rocks that are associated with these, such as granite, porphyry, and hornblende rock; and sometimes, also, in the more ancient of the secondary strata. The veinstone in which the gold occurs is most generally quartz. In Transylvania small quantities of an ore have been found, in which gold is in combination with a considerable proportion of the rare metal *Tellurium;* and there is a kind of iron pyrites—that is, a sulphuret of iron,—not of very unfrequent occurrence, which contains minute scales of pure gold interposed between the laminæ of the pyrites. When gold occurs in veins in solid rocks, it is sometimes regularly crystallized. In the splendid collection of minerals belonging to the Russian noble, Prince Demidoff, there are many beautiful crystals of gold from the Ural Mountains. By far the greatest proportion of this metal, in all countries which produce it, is obtained from alluvial soils, or deposites, where the gold is found in scales, grains, and lumps, rounded by attrition: so that the metal has evidently been derived from pre-existing rocks, in which it was disseminated either in minute scales or veins, and which have been broken up; the fragments having been abraded by the action of water in the same manner as the pebbles of tin-stone in the stream-works of Cornwall, and other places. For the sake of convenience, we shall call this "*stream-gold.*" It is found in the sand and gravel of the beds of many rivers and smaller streams in most countries of the world; but the chief quantity is met with in extensive alluvial deposites, formed by other aqueous causes than the water of existing rivers. The lumps of gold, in such situations, are of very various sizes; and masses have been found in the Ural Mountains of eighteen and twenty pounds weight,—in Colombia, of twenty-five pounds; and one is said to have been found near La Paz, in Peru, of nearly forty-five pounds weight, the value of which, if estimated at 3*l.* 10*s.* per ounce, would be 1890*l.* A considerable portion of stream-gold appears to have been derived from auriferous pyrites; for almost all the sands from which this metal is gathered are of a deep blackish-brown color, and are highly ferruginous. It is a remarkable and not a very explicable circumstance that, in countries which contain deposites of alluvium rich in gold, and the materials of which must have been derived from rocks at no very great distance, it has rarely happened that the attempts to find the metal in the neighboring rocks have been successful. It may be asked, how gold comes to be so often found in alluvial soils, and that other metals should not be met with in the same way? Platinum is so found, and so is silver, but only very rarely. The reason is, that the ores of other metals are liable to decomposition by exposure to air and moisture; and, therefore, although they might have been originally in fragments, like the other materials of the rocks that were broken up, they would gradually disappear by decomposition; whereas the gold, from its indestructible nature, remains unchanged, except in form. In the same way stream-tin has been preserved, because the oxide of tin is not affected by air and moisture.

To describe the methods employed to separate gold from the other minerals with which it is combined would lead us into

somewhat tedious details. The great value of gold makes searching after minute quantities profitable, which would never be practised with other metals. The usual mode of separation is by a process called *amalgamation*, which is founded on the property which mercury (or quicksilver) has of combining very readily with gold, and of being easily separated from it again by the application of heat. The etymology of the word is Greek, viz., *ama*, *together*, and *gameo*, *to marry;* expressive in this way of the union of the gold with the quicksilver. Amalgamation is effected in this manner: the ore, broken to pieces and freed as much as possible from stony impurities, is reduced to powder, and made up into a paste with salt and water. Quicksilver in proper proportion is added, and the whole is well beaten and shaken together, and kept at the temperature of boiling water for some days, till the union is effected; after which the earthy matter is washed away, and the residue is subjected to distillation, by which the quicksilver is separated, and at the same time recovered in great part, and the gold, usually containing a little silver, is left behind. This is the usual process followed in Mexico and South America. In Hungary the gold is generally purified by another process, called *cupellation*. This depends on the property which lead and copper, the metals with which the gold is there mixed in the ores, have of attracting oxygen from the air when exposed to a strong heat, and which the gold does not. The ores are well roasted, to drive off the sulphur they usually contain, and are fused in several successive operations. The metallic mixture, freed from stony matter thus obtained, is put into a vessel made of bone-ashes, called a *cupel;* it is made of that material because it forms a porous texture, and is, at the same time, very refractory in the fire. A strong blast of intensely-heated air is now made to pass over the metal in a state of fusion, and the lead and copper becoming oxidated, are absorbed by the cupel, or skimmed off, and the gold is left behind. The lead is the great agent, for its oxide is easily fusible into a glassy substance, which sinks into the cupel, carrying the other impurities along with it; so that if the ore does not naturally contain much lead, a portion is added. We have described these processes only very generally: there are many delicate manipulations in the mode of conducting them, upon which success in the result greatly depends.

In our next section we shall proceed to describe the principal sources from which gold is derived. The 'Historical Inquiry into the Production and Consumption of the Precious Metals,' by William Jacob, Esq., may be consulted with advantage by those who are desirous of minute information; and we have ourselves relied upon it for many of the facts contained in the following sections.

Lead. — The appearance of this substance in its metallic state is undoubtedly familiar to every one. It is one of the most useful of mineral substances, and forms one of the most valuable products of the mines of Great Britain. Its specific gravity is considerable, being more than eleven times the weight of an equal bulk of water. It is malleable, and with ease may be reduced into very thin plates; but it is liable to crack under the hammer. It is so far ductile as to be capable of being drawn into wire $\frac{1}{18}$ part of an inch in thickness, but its tenacity is very low; for a wire of that diameter breaks with a weight a little exceeding eighteen pounds. As it possesses no elasticity, it is incapable of compression, and differs in that respect from all the other ductile metals, which diminish in volume, and, consequently, increase in density, under the hammer; but lead has the same specific gravity when it is simply melted as when it is beat or rolled out into plates. It is the least sonorous of all the metals. It is easily fusible, melting at 612°, or a heat less than three times that of boiling water; but not so easily as tin, which melts at the temperature of 442°. When first melted, or when cut, it has a brilliant lustre; but this shining surface, however, is soon tarnished by attracting oxygen and carbonic acid from the air: but this coating of carbonated oxide, once acquired, protects it from farther change. Water has no action upon it: and hence its usefulness for cisterns and pipes. When exposed to the continued action of a stream of hot air, it rapidly acquires oxygen, and is converted into a substance which is called "litharge."

Lead has been sometimes found in the pure, or native state; but very rarely, and always in small quantity. It is one of the metals which is found in the greatest variety of combinations: but there is only one kind of ore which is very abundant; the rest are chiefly known as objects of interest to the mineralogist; many of them afford very beautiful specimens for the cabinet. The common ore is a combination of eighty-six parts of lead and fourteen of sulphur, and is called usually by the name of *Galena*, or sulphuret of lead. It very often contains silver, and in sufficient quantity to pay the expense of a process for separating it. That of the north of England contains from 2 to 24 ounces of silver to the ton, and the average quantity is 11½ ounces. The galena

of the mine Huel Pool, in Cornwall, yielded 60 ounces; of Guarnock Mine, near Truro, 60 ounces; and a mine near Beeralstone, in Devonshire, yielded galena so rich as to give 135 ounces of silver to the ton. A great proprietor of lead mines in the north of England had a splendid service of plate made of the silver so separated from the lead ore.

In geological position, lead is most abundantly met with in the lower strata of the secondary sedimentary deposits, especially in the carboniferous limestone. It is found also in considerable quantity in the strata below these, in the grauwacke, clay-slate, mica-slate, and even in gneiss, which is the lowest of the stratified rocks. It is found also, but more rarely, in the unstratified rocks, both in granite and in trap; but in all the instances that have been mentioned, the granite and trap have always been associated with stratified rocks containing lead ore. It is occasionally found in the coal-measures, but not hitherto in any of the strata above the coal. Galena, next to pyrites, or sulphuret of iron, is the most common of the metallic ores, and it is found in almost every country of the globe; but there are large tracts without any deposits of it in sufficient abundance to be worked.

England produces annually nearly three times as much lead as all the other countries of Europe put together. The chief mines are in the north of England, in Derbyshire, North Wales, and Devonshire, on the borders of Cornwall. The great seat of the north of England mines is that high district around the mountain of Cross Fell, where the counties of Northumberland, Cumberland, Westmoreland, the North Riding of Yorkshire, and Durham, meet, as it were, in a central point, and from which they radiate. The mines first become of importance on Muggleswick Moor, on the borders of Northumberland and Durham, about twenty-seven miles from the east coast of Sunderland, and at Blanchland, on the river Derwent, a little to the west of Muggleswick; and they continue to the summit of Cross Fell. Aldstone Moor, in Cumberland, and Dufton, in Westmoreland, are important places in this district; and there are mines in Weardale, Teesdale, Allendale, and Askendale. Mr. Forster reckons that, in this part of England, there are no less than 175 lead mines, which either have been or are now worked. The prevailing rock is the carboniferous limestone,—that great deposit which lies immediately under the coal strata in most parts of England. It is associated with strata of sandstone and slate; and there are about twenty different beds of limestone which the miners distinguish by distinct names. The series of strata at Aldstone Moor, according to a section given by Mr. Winch, consists of about sixty alternations of slate, sandstone, and limestone, in 159 fathoms, or 954 feet. The whole are covered by the coarse sandstone commonly known by the name of "millstone grit." The above dimensions are only a part of the strata where they are bored through in sinking the well, or shaft of a mine; but if we include the whole deposit from the upper surface of the old red sandstone, on which the series rests, we obtain a total thickness of nearly 2800 feet. Beds of trap, one of which is particularly designated the "Whin Silt," a miner's term, are interposed between the strata in several places. The lead ore occurs in veins, which traverse the strata in various directions, and in many irregular ways, sometimes being very slender, at other times extending to great widths. They are usually of larger dimensions in the limestone than in the slate and sandstone: one vein, which is seventeen feet in a limestone stratum, contracts to three feet in the sandstone below; and they are always much richer in ore, even in proportion to their magnitude, in the limestone. That part of the series which is richest in lead does not exceed 300 feet. The mineral substances which accompany the ore, forming what is called the "vein-stone," are calcareous spar, fluor spar, quartz, and a few others of less frequent occurrence. The mines in this part of England have yielded, of late, on an average, about 25,000 tons of lead annually, which is more than one-half of the whole produce of Great Britain; and of that amount nearly a third is obtained from the mines belonging to Greenwich Hospital. In the year 1831, 28,000 tons were raised from the mines of Cumberland, Northumberland, and Durham.

The lead mines of Derbyshire are situated in the north-western part of the country, extending as far south as the neighborhood of Matlock. That district is almost wholly composed of the carboniferous limestone, which is surrounded on all sides by the millstone-grit that lies above it. The limestone is very much disturbed in its stratifications, and is intersected by dikes and beds of trap. There are limestones of various qualities and colors in the series, chiefly of a grey and fawn color, but sometimes quite black; and several of the beds being of a texture which receives a good polish, they are used as marbles for architectural and ornamental purposes. The limestone-beds contain numerous great caverns, which are often visited by travellers. The ore is galena; but it contains in general too little silver to repay the cost of

extracting it. The vein-stones that accompany the lead ore are usually calcareous spar and fluor; the latter being the substance which is so generally known by the name of "Derbyshire Spar,"—a beautiful mineral, and capable of forming handsome vases, and such like ornaments. This mineral is a compound of lime with a peculiar acid, which, from having been first found in it, was called "fluoric acid." Farey, in his 'Mineral Survey of Derbyshire,' enumerates no less than 280 mines, which had been, or were then (1811,) working.

Next in importance to the mines of the north of England, those in North Wales, in Flintshire, and in Denbighshire, are the most productive: a small quantity is raised in Shropshire, and in the neighborhood of Tavistock in Devonshire. Lead ore has been found in different places in the Isle of Man, and mines were worked there in the reign of Henry IV.; they were even in some activity as late as the early part of the last century, but they are now almost given up. It is found in the counties of Down and Wicklow in small quantities, sufficient, however, to be worth working. The lead mines of Scotland are more productive. The most important are those situated in the grauwacke, or slate-rocks, composing the range of hills which runs quite across the south of Scotland, from St. Abb's Head, north of Berwick, and in that part of it called Lead Hills and Warlock Head, on the borders of the counties of Lanark and Dumfries, north-east of Sanquhar. These mines were discovered in the year 1540, and have yielded large revenues to the proprietors ever since. The veins traverse the grauwacke rock from north to south, and very considerably in thickness, some of the principal ones being from four to ten feet in width. At one time, the Susannah vein exhibited a mass of solid ore no less than fourteen feet thick; this was probably a junction into one of several small veins. Some years ago, the mines of Lead Hills and Warlock Head together yielded about 2400 tons annually. Lead has been wrought at Tyndrum, in Argyleshire, where the ore is found in a bed of quartz, which is part of a series of strata of the primary rock, mica slate; and also at Strontian, in the same county, where the galena traverses gneiss, the oldest of the primary strata. The produce of the different lead mines in Scotland was at one time estimated to amount to 4800 tons, but it has, of late years, fallen off very considerably. Mr. Taylor, in his 'Records of Mining,' gives an account of the quantity of lead raised from the mines of Great Britain in the year 1828, which, he says, was the result of a careful inquiry among those best acquainted with the subject. It is as follows:

	Tons.
North of England Mines -	- 28,700
Derbyshire and Shropshire	- 4,800
Devonshire and Cornwall -	- 2,000
Flintshire and Denbighshire	- 12,000
Scotland - - - - -	- 1,000
Ireland, Isle of Man, &c.	- 500
	47,000

Five years prior to this, the whole amount was only 36,000.

Method of obtaining the Metal from the Ore.—The ore, after having been properly broken, and separated as much as possible from the vein-stones, is roasted in a furnace, with a small quantity of coal, in order to expel the sulphur, and any other volatile matter which it may contain. After undergoing this process, it is taken to a blast furnace, of a peculiar construction, called an "ore-hearth," where, by a powerful heat, the ore is melted, and the metal separated from the dross, or slag, which swims on the surface; the mass being frequently stirred, to facilitate the separation, for a period of from twelve to fifteen hours. There are various manipulations during the process, and these, together with a supply of fuel and of lime (which is added to facilitate the reduction), are modified according to the nature of the ore, and require much skill and tact on the part of the workman. The slags, still containing a portion of lead, are subjected to another process of smelting with coke in another furnace. In all these operations a considerable quantity of the ore is volatilized, and condenses in the chimneys of the furnace: this, which is called "smelters' fume," is collected from time to time, and the lead is extracted from it.

The quantity of silver contained in the greater part of the lead ore raised in the north of England is sufficient to render its extraction profitable. The separation of lead and silver is effected by the different degrees of attraction which the two metals have for oxygen, the silver remaining unaltered, when exposed to the air of the atmosphere at a high temperature; whereas lead, under the same circumstances, becomes rapidly converted to a protoxide;—that is, becomes a new substance, composed of lead and a minimum quantity of oxygen, and which is commonly known by the name of "litharge." The lead to be refined is placed in a furnace so constructed as to admit of the ready separation of the litharge as it is formed; it is melted and farther heated till it becomes of a bright red, and then the blast of air is made to

pass over it. This not only supplies the oxygen, but is sufficiently strong to sweep away the oxide as it is formed, by which means a fresh surface of the melted lead is exposed: more lead is supplied, from time to time, as the operation proceeds, and, at the end of the process, a cake of silver is found at the bottom of the furnace. The lead is recovered from the litharge, by a very simple process, which consists in mixing it with coal, and exposing it to a strong heat: the carbon of the coal has a stronger attraction for oxygen than lead has, and therefore separates it from the litharge, leaving the pure metal, which is run out into moulds to form the pigs, or bars, in which shape it is brought to market. This process of extracting the silver from the lead was not introduced in the north of England mines till the reign of William and Mary.

The working of lead mines in Great Britain dates from a remote period. The mines in Derbyshire, it is supposed, were wrought in the time of the Romans; the proofs of which are derived from blocks or bars of lead which have been found with Roman inscriptions upon them. A bar of this kind was discovered on Cromford Moor in the year 1777, and the interpretation of the inscription which has been given is the following: "The Sixth Legion inscribe this in memory of the Emperor Adrian." Another bar was met with near Matlock in 1783, the inscription of which has been translated as follows: "The property of Lucius Aruconius Verecundus, merchant of London." The Saxons and Danes, it is supposed, were also engaged in working the mines of Derbyshire, from the designation of the Odin Mine, at Castleton, which it is conjectured was so called from the name of the northern deity.

Uses of Lead.—Besides the various purposes to which it is applied in its pure state, lead is employed in many different ways in combination with other substances. The sulphuret of lead—that is, the common ore, galena—is made use of, without any previous preparation, as a glazing for coarse pottery. The protoxide, or litharge, enters largely into the composition of flint-glass, which it renders more fusible, transparent, and uniform. Combined with another proportion of oxygen, it forms *Red Lead,* which is also used in the manufacture of flint-glass, and as a paint. *White Lead,* which is so extensively used as a paint, is a combination of the metal with oxygen and carbonic acid. *Sugar of Lead,* which is used very largely in several manufactures, particularly in calico printing, and also in medicine as an external application, is a compound of lead and acetous acid, or vinegar. It is so called from having a remarkably sweet taste: it is well known, as well as most of the combinations of lead, to be a deadly poison.

Of the 45,000 tons of lead which may be estimated as the average produce of the mines of the United Kingdom, about one-third is exported. In the year ending January 5, 1833, the exports were as follows:

	Tons.
In pigs, and rolled, and shot, -	12,181
Litharge - - - - - - - - -	433
White Lead - - - - - - - -	652
Red Lead - - - - - - - -	396
Lead Ore - - - - - - - -	236
Total - -	13,898

The countries to which that quantity was exported were,—

	Tons.
United States of America - -	4,896
East Indies and China - - -	2,980
Russia and Sweden - - - -	1,951
Germany - - - - - - - -	634
Brazil - - - - - - - - -	526
West Indies - - - - - - -	514
British North America - - -	480
The Netherlands - - - - -	456
Cape of Good Hope and Africa	435
New South Wales - - - -	223
Italy and the Levant - - - -	226
Spain and Portugal - - - -	226
Other places in lesser quantities	351
Total - -	13,898

No species of property, perhaps, has undergone so great a deterioration in so short a time as that of lead mines. In the year 1809, the market-price of lead in bars was £31 3s. per ton; and, according to the tables given by Mr. Macculloch in his 'Commercial Dictionary,' the average price for the ten years ending 1810 was £27 14s. 6d. It rose to £31 in the year 1814, when speculations at the close of the war raised the value of many of our native products; but the average of the ten years ending 1820 was £23 6s. 6d. A sudden fall took place five years afterwards, for in 1825 the price was £25 6s., and the following year it fell to £19; and it kept falling till 1832, when it was down to £13 10s. From that extreme depression it has partially recovered, the present market price being about £18 per ton. This extraordinary fall was occasioned by a sudden increase of supply from the lead mines of Spain. These mines are situated in Andalusia, partly in a range of mountains to the north of Jaen, near Linares, but chiefly in another range which lies between Jaen and the city of Granada, and on the southern slope of them. We know little about

these mines beyond their locality, for the geology of Spain is as yet very imperfectly understood. Bowles, who wrote in the year 1776, describes the mines to the north of Jaen to have been worked by the Moors, and says that the mountains are pierced by shafts in all directions; that there are two great veins which pass through granitic rock, which vary considerably in richness; and that at one time one of the mines produced in a year more than all the lead mines of Saxony together had done in twelve years. But it is the mines in the mountains of Granada from which the recent great supply has been obtained. The ore lies near the surface, and is therefore obtained without much exercise of skill, or expense of labor and machinery. Mr. Witham says, that "the metalliferous limestone of the south of Spain is so rich in galena as to furnish, even in the present imperfect state of mining in that country, about 20,000 tons of lead annually. France has some lead mines in Britany, Languedoc, Alsace, and other parts of her territory, but imports the greater part of her consumption, and chiefly from Spain; England having sent only 70 tons to France out of the 13,898 exported in 1832. There are many lead mines in Saxony, Bohemia, Silesia, and other parts of Germany. Although the exports to the United States from this country are so considerable, they are not without ores of that metal in their own country. The mines are situated in Pennsylvania, Massachusetts, and on the Fever and Missouri river in the Western States; the richest being in the latter country. The total produce in 1829 exceeded 6000 tons.

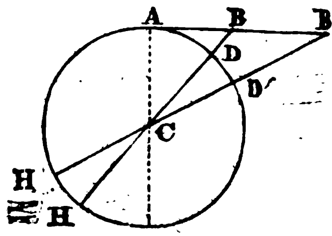
[For the Mechanics' Magazine.]

LEVELLING.

It is not my object, in preparing this article, to give the whole system of levelling, in all its branches; but merely to give an idea of its principles, enough to enable the reader to take the level of any short distance without the trouble and expense of calling the assistance of professional men; but before entering directly upon the subject, it is necessary to give a general denomination.

Two or more points are said to be on a level when they are equally distant from the centre of the earth,* or from the surface of a tranquil fluid, supposed to be situated immediately above or below them. A level surface, therefore, is one that is every where perpendicular to a plumb-line, or the radius of the earth considered as a sphere. This is called a *true level*, while a strait line or plane, that is perpendicular to the radius of the sphere or plumb-line only at one point, is denominated an *apparent level*. Thus, AB represents an apparent level, AD a true level, and BD the deviation of one from the other, or the *difference of level* of the points A, B, referred to a tangent at A.

Fig. 1.



Knowing the tangent AB, we readily find BD by the proportion, BH : AB : : AB : BD; which gives $BD = \frac{AB^2}{BH} = \frac{AB^2}{2CD + BD}$.

But, as BD is always small in comparison with 2CD, the diameter of the earth, it may be neglected in the second member of the above equation;* and, in most cases, for the same reason, AD may be considered as equal to AB; whence, $BD = \frac{AD^2}{2CD}$.

In like manner, for another distance AD′, we shall have, $B'D' = \frac{AD'^2}{2CD}$; and $BD : B'D' :: \frac{AD^2}{2CD} : \frac{AD'^2}{2CD} :: AD^2 : AD'^2$.

That is, *the difference of level for different distances is as the square of the distance.*

The distance AD being supposed, for example, = one statute mile, or 5280 feet, and 2CD, the diameter of the earth, = 7912 miles, or 7912 × 5280 feet, we have

$$BD = \frac{(5280)^2}{7912 \times 5280},$$

and by logarithms,

5280	- - 2 log.		7.44521
7912	- - log.	3.89829	
5280	- - log.	3.72263	
			7.62092
			—1.82434

0.6073
12

BD = 8.0076 inches.

Thus, the difference between the apparent and true level, answering to a distance of one mile, is 8 inches.

* The small errors committed by supposing the earth a sphere instead of a spheroid, are safely neglected in the common operations of levelling.

* If it were necessary, we might obtain the difference of level without neglecting BD. Then from the above equation we obtain $BD^2 + 2CD \times BD = AB^2$; or, calling BD x, CD a, and AB b, $x^2 + 2ax = b^2$, and $x = -a + \sqrt{b^2 + a^2}$.

For any other distance, as $2\frac{1}{2}$ miles for instance, instead of repeating the above process, we can use the proportion,

$1^2 : 2.5^2 : 8$ inches : 50 inches.*

Fig. 2.

We will now proceed direct to the subject.

F is the formation, and E the place assigned to carry the water to; the distance we will suppose to be half a mile.

Note. To perform this business, you must be provided with two staves graduated in inches and tenths, which may be from 4 to 6 feet long; and also a water level, which may be made easily at any joiner's shop; the level may be of any convenient length, dug out hollowing, so as to hold water; with sights at the top to make the observations through; having provided these, go to the fountain with two assistants, and observe the following rule:

Rule. Order the first assistant to the fountain with one staff placed perpendicular; and the second assistant to any convenient place, as at A, with his staff perpendicular; then place the water level in the middle, as at W; then looking through the sights, order the first assistant to move a piece of white paper up and down the staff till you can see it through the sights; then order him to note the distance it rests from the ground; and, going to the other end of the level, order the second assistant to do the same; after this is done, order the first to take the place of the second, and the second to take a new stand at B; place the water level, and proceed as before, marking down the distance the white paper rests as before, and then take another stand, and proceed till the second arrives at the destined place, at E; then have the assistants cast up their notes, and as much as the second assistant's notes exceed the first, so much does the ground descend; and as much as the second assistant's notes are less than the first, so much does the ground rise. In the above example, the assistants' notes are as follows:

1st assistant's notes—

1st station,	- - -	0 ft.	7 in.
2d "	- - -	1	0
3d "	- - -	0	2
4th "	- - -	1	2
5th "	- - -	0	4
		3	3

2d assistant's notes—

1st station,	- - -	1 ft.	0 in.
2d "	- - -	0	6
3d "	- - -	1	6
4th "	- - -	0	2
5th "	- - -	0	7
		3	9

The second assistant's notes exceed the first by 6 inches; of course the ground is 6 inches lower at E.

Thus, by the rule—$1^2 : 5^2 :: 8 :: 16$, about two inches for the allowance of the earth's curvature—that is, allowing the distance to be .5 or half a mile, as stated above.

S. A.

Mistakes in Education.—The following extract from President Vethake's Address at his recent inauguration as President of the Washington College, Va., points to a common evil of popular education. The author is himself a sound and practical instructor, of much experience, and speaks advisedly.

"Another reason why young men in our colleges are tempted to neglect the general cultivation of their minds, and to devote their whole study to the storing of their memories with the contents of the text-books put into their hands, is, that their comparative scholarship is very apt to be estimated by their instructors, not so much by the *nature* of the question which they are able to answer correctly, and by the amount of thinking and originality displayed, as by the promptitude and fluency with which they can repeat what they have servilely learned. I have been told by more individuals than one, and by graduates of more institutions than one, that on discovering, while at college, the fact to be as I have just stated, and being anxious that the best account of them should go to their friends from their professors, they at once resolved to subject themselves to the

* The difference of level for a mile being in feet $\frac{5280 \times 5280}{7912 \times 5280}$, or $\frac{5280}{7912}$; that is, $\frac{2}{3}$ very nearly, and the difference of level for any other distance being as the square of the distance, we have the following convenient rule for finding the difference of level, namely, *take two thirds of the square of the distance in miles for the difference of level in feet nearly. Thus, in the above* example, $\frac{2}{3}(2\cdot5)^2$, or $\frac{2}{3}\,6\frac{1}{4} = 4\frac{1}{6}$ feet, or 50 inches.

drudgery, and that by so doing, they did not fail to secure the object they had in view. The persons of whom I spake were young men of talent, as well as ambitious of immediate distinction. Had their minds at the time been sufficiently matured to have adequately appreciated the uselessness and the folly of this method of study, without at the same time being matured enough to adopt, of their own suggestion, a more efficient and rational method, and had they been less influenced by present rewards, without as yet aspiring to the more substantial rewards of a future reputation among men, or without the loftier stimulant of duty, they might have become, like others, among their fellow students, altogether negligent of their improvement, and perhaps have contracted the most ruinous habits. It is to the system of education upon which I am animadverting, together with the mistakes made by the members of a college faculty, in deciding on the comparative scholarship of the students—which mistakes the latter are competent to judge of with a good deal of accuracy — the anomaly, so often remarked, of a young man's relative *standing* while in college being often but so little indicative of his future standing in the world, is to be ascribed; and the explanation is likewise manifest why some individuals of peculiar energy of character, after wasting their time in almost complete idleness while at college, astonish their friends nevertheless by the intellectual exertion of which they show themselves to be capable when an adequate motive is presented for exerting their energies. This resolves the mystery, too, why so many *self-taught* men have, in despite of the disadvantages under which they labored, surpassed the graduates of colleges in usefulness and reputation; every acquisition made by a self-taught man, in consequence of the very difficulty of making it, being accompanied by a contemporary sharpening of his intellect, which the passive recipient of another's knowledge never experiences."

"So was Franklin,"—O you're a 'prentice," said a little boy the other day, tauntingly, to his companion. The addressed turned proudly around, and while the fire of injured pride and the look of pity were strangely blended in his countenance, coolly answered, "*So was Franklin.*"

The motto of our infantile philosopher contains too much to be forgotten — and should be engraved on the minds of all. What can better cheer a man in a humble calling, than the reflection that the greatest and best of earth—the greatest statesmen—the brightest philosophers, and the proudest warriors—have once graced the same profession?

Look at Cincinnatus! At the call of his country he laid aside the plough and seized the sword. But after wielding it with entire success — when his country was no longer endangered, and public affairs needed not his longer stay — he "beat his sword into a plough-share," and returned with honest delight to his little farm.

Look at Washington! What was his course of life? He was first a farmer; next a commander-in-chief of the host of freedom, fighting for the liberation of his country from the thralls of despotic oppression; next, called to the highest seat of government, by his ransomed brethren, a President of the largest republic on earth; and lastly, a farmer again.

Look at Franklin! He who

"With the thunders talked, as with a friend,
And waved his garland of the lightning's wing,
In sportive twist."

What was he? a PRINTER! once a menial in a printing office! Poverty stared him in the face—but her blank, hollow look could not daunt him. He struggled through a harder current than most are called to encounter; but he did not yield. He passed manfully onward, bravely buffeting misfortune's billows, and gained the desired haven!

What was the famous Ben Jonson? He was first a brick-layer or mason! What was he in after years? 'Tis needless to answer.

But shall we still go on, and call up in proud array all the mighty host of worthies that have lived and died, who were cradled in the lap of penury, and received their first lesson in the school of affliction? Nay, we have cited instances enough already; more than enough to prove the point in question; namely, that there is no profession, however low in the opinion of the world, but has been honored with earth's greatest and her worthiest.

Young man! Does the iron hand of misfortune press hard upon you, and disappointment well nigh sink your despairing soul? Have courage! Mighty ones have been your predecessors — and have withstood the current of opposition that threatened to overwhelm their fragile bark!

Do you despise your honorable station, and repine that you are not placed in some nobler sphere? Murmur not against the dispensations of an all-wise Creator! Remember that wealth is no criterion of moral rectitude, or intellectual worth; that riches dishonestly gained are a lasting curse; that virtue and uprightness work out a rich reward; and that

"An honest man's the noblest work of God."

And when dark disappointment comes, don't wither at her stare; but press forward, and the prize is yours! It was thus with Franklin; it can be thus with you. 'Tis well worth contending for, and success may attend you; and the "stars" will be brighter than the "stripes."—[Utica Record of Genius.]

The annexed account of the elevation of *Menschikoff* from the station of a pastry-cook's waiter, to be first and confidential minister under three monarchs, is a striking illustration of the truth of the maxim, that, "every man may be the architect of his own fortune." It shows conclusively that a man of talents, industry, and prudence, may rise, notwithstanding the obstacles with which he may find himself surrounded, to the most elevated stations in society; and it also shows that, with all the advantages of the most elevated stations, without honesty and virtue, he is liable, and not only *liable*, but almost sure, to be precipitated from his elevation, to the depths of degradation and misery. How true, then, is that maxim which should be familiar to every *boy*, as well as man,

"Honor and shame from no condition rise;
Act well your part, there all the honor lies."

Alexander Menschikoff, the son of a peasant, born near Moscow, in 1674, was employed by a pastry-cook to sell pastry in the streets of Moscow. Different accounts are given of the first cause of his rise. According to some statements, he overheard the project of a conspiracy by the Strelitz, and communicated it to the czar; other accounts represent him as having attracted the notice of Lefort (q. v.), who took him into his service, and, discerning his great powers, determined to educate him for public affairs. Lefort took the young Menschikoff with him on the great embassy in 1697, pointed out to him whatever was worthy of his attention, and instructed him in military affairs, and in the maxims of politics and government. On the death of Lefort, Menschikoff succeeded him in the favor of the czar, who placed such entire confidence in him, that he undertook nothing without his advice; yet his passion for money was the cause of many abuses, and he was three times subjected to a severe examination, and was once also condemned to a fine. The emperor punished him for smaller offences on the spot; but much of his selfishness and faithlessness was unknown to his sovereign. He was much indebted, for support, to the empress Catherine. He became first minister and general field-marshal, baron and prince of the German empire, and received orders from the courts of Copenhagen, Dresden, and Berlin. Peter also conferred on him the title of duke of Ingria. On the death of Peter, it was chiefly through the influence of Menschikoff that Catherine was raised to the throne, and that affairs were conducted during her reign. (See *Catherine I.*) When Peter II. succeeded her on the throne, Menschikoff grasped, with a bold and sure hand, the reins of government. In 1727, when his power was raised to the highest pitch, he was suddenly hurled from his elevation. Having embezzled a sum of money which the emperor had intended for his sister, he was condemned to perpetual exile in Siberia, and his immense estate was confiscated. He passed the rest of his life at Berezov, where he lived in such a frugal way, that, out of a daily allowance of ten roubles, he saved enough to erect a small wooden church, on which he himself worked as a carpenter. He sunk into a deep melancholy, said nothing to any one, and died in 1729. Menschikoff was selfish, avaricious, and ambitious, implacable, and cruel, but gracious, courageous, well informed, capable of large views and plans, and persevering in the execution of them. His services in the promotion of civilization, commerce, the arts and sciences, and in the establishment of Russian respectability abroad, have been productive of permanent effects.

We have been favored with the following answer to a request made in No. 1 of the Apprentice's Companion, in relation to the bequest of Dr. Franklin, to the town of Boston, for the benefit of young mechanics.

To the Editor of the Apprentice's Companion:

Sir,—In the first number of the Companion you republished that part of Doctor Franklin's will by which he bequeathed £1000 sterling to the inhabitants of the city (then town) of Boston, and the same sum to the inhabitants of the city of Philadelphia, for the purpose of establishing a fund in each city for the benefit of young mechanics, to assist them by loans "in setting up their business." In remarking upon which, you said, "Of the success of this noble offer we are entirely uninformed, and would request some one familiar with the subject to communicate the facts." As respects the bequest to the inhabitants of Boston, the facts are these: The town ac-

cepted the donation, and the money was received, and by the municipal authority appropriated conformably to the provisions of the will. The fund, however, has not accumulated *to the extent* of the benevolent doner's calculation. Whether this deficiency is the effect of losses, or a lack of borrowers, or of both, I am not informed. Probably it is the effect of these conjointly.

The value of the fund on the 30th day of April, 1834, was stated by the city auditor, in his annual report, to be $29,551 91; but it would have been $36,285 16 had it drawn a compound interest of 5 per cent. during the *whole* time of its subsistence, and had there been no losses. For, as Dr. Franklin died on the 17th day of April, 1790, and the project was to go into operation within one year after his death, it had then been in operation 43 years and 13 days, in which time it would have increased to a little more than eight times the original sum. It is manifest, however, from the above-mentioned report, that it had not increased at the rate of five per cent. from year to year, during the *whole* time, for during the year *preceding* the 30th of April, 1834, the increase is stated to be only four and a half per cent. The number of persons who have already received assistance from this benevolence, is two hundred and fifty-three.

It will be seen by the results above stated, that the benevolent wishes of Dr. Franklin in regard to this donation have hitherto been, to a considerable extent, realized, and that there is now a valuable fund, which is constantly increasing, under the supervision and management of the city government, appropriated to the prudent use of a deserving class of citizens, which fund, should the future increase be only in the proportion that it has hitherto been, must amount to a vast sum in the course of two centuries.

It is to be hoped that some of your Philadelphia correspondents will gratify the public with a statement of the results of the bequest to that city.

Yours respectfully,

D. H.

We thank D. H. for his prompt reply, and again repeat our request that some one familiar with the condition of the fund in Philadelphia, will communicate the facts for the information of all who admire the liberality, and revere the memory, of the doner.—[Ed. A. C.]

Digestive Apparatus of Animals. — There are some families of fishes, as the mullets of Africa, possessing the gizzard of fowls—digestion in the stomach being performed apparently by mechanical means, —attrition, through the direct agency of a collection of gravel. A question arises here, whether they are partial to animal food, a distinguishing trait in the physical characters of fishes. Within about thirty years it has been very satisfactorily ascertained that the great basking shark, once viewed as a terrific, voracious monster, prowling through the ocean in search of dead men's bones, is a quiet, unoffending, cowardly compilation of flesh, perfectly content to feed on floating sea weed. For the purpose of extracting the nutrition, and also for an economical expenditure of vital energy, the stomach is an immensely capacious pouch, into which a cart-load may be stowed away for future want. Below this, the intestinal canal is prolonged, as in the herbivarous quadrupeds, nearly twice the length of the body: but as a still further mechanical security, a continuous valve or shelf juts out from the inner circumference, past the centre, running the entire length, to prevent the too rapid descent of the food. Thus, being exposed to the action of such a prodigious absorbing surface, not a particle is lost till all its substance capable of being converted into blood has been conveyed away by the lacteals. Some birds are organized for digesting the kinds of food peculiar to bears and wolves; and others gorge living prey, much after the manner of the ophidians. Into whatever system of animal organization we cast an inquiring eye, we are confounded by the diversity of mechanical contrivances for sustaining the active principle of life.—[Scientific Tracts.]

[From the London United Service Journal.]

Lang's Patent Cordage.—The manufacture of cordage is an object of paramount importance to a maritime country, although the consumption of hempen rope has lately been more successfully invaded by the use of iron chains, than ever it was by the various attempts made with hides, wool, grass, and other materials. We have, therefore, perused the pamphlet circulated by Macnab and Company, of Greenock, with considerable interest, and can recommend it to the notice of our readers as a clear exposition of a most useful invention.*

The art of rope making had been a sort of *rule-of-thumb* process till our own

* Exposition of the Principles of Mr. J. Lang's Invention for spinning Hemp into Rope Yarns by Machinery, and its effect on the strength and durability of Cordage.

days: and no very serious attempts were made to correct the obvious defect of different tension on the component parts of the twisted strand. The science of Huddart, however, and the practice of Chapman, were brought to bear upon this important point, and introduced the principle, by which an increase in the strength of the cordage was effected by simply so constructing the rope as that every yarn is made to bear its own proportion of the strain. And it is by carrying this principle to its utmost that Mr. Lang has been enabled to effect an additional increase of strength, and, consequently, of durability to the rope. This has been accomplished by means of a machine affording a more just arrangement, regular twisting, and equal bearing of the fibrous substances which are employed in the composition of the yarns, than any heretofore used.

The utility of such an improvement, upon what has been aptly termed "the very sinews and muscles of a ship," will be manifest, by recurring to the well known question of M. Reaumur, as to the strength of ropes made of twisted strands, compared with those composed of parallel parts, selvage fashion; in other words, whether the strength of a cord was greater or less than the sum of the strength of its threads. After gathering all that could be urged for and against twisting, the philosopher had recourse to experiment to decide between them. The result was, that contrary to all expectation, the twisting was found to diminish the strength of the rope; whence it was readily inferred that it diminishes it the more as the rope is the thicker. For, inasmuch as the twisting diminishes, the more twisting the more diminution, according to the system in use previous to Captain Huddart's making the yarns all bear an equal proportion of the strain. Successive improvements caused the strands to be laid more uniformly in the rope, and every strand to receive an equal degree of twist, by which the rope was rendered stronger, and of a general degree of strength throughout.

By Mr. Lang's invention, all the former principles are carried into still greater effect; and by it the regular spinning of yarns, which had hitherto been prepared in a tedious and clumsy manner by hand labor, is accomplished. But a still more important object has been achieved. By the same plan, the hemp, to whatever purpose applied, being drawn over a succession of gills, or small hackles, is dressed in the highest degree: hence the fibrous substances of the hemp are regularly split and subdivided; they are also multiplied to such an extent, that their number in a patent spun yarn will be found more than double the quantity of those which compose a hand-spun yarn of equal girth, which must increase its strength in no inconsiderable degree. Again, while the fibres are thus greatly multiplied, they are also completely elongated and laid straight, so as to admit of being regularly twisted, and each fibre being stretched its full length, and laid parallel to others in the yarn, they are all made to bear at the same time, and equally, in the strain; thus every fibre of the hemp is called into action, and contributes its own proportion of strength to the fabric. Nor is this all. By hand labor the hemp can only be spun from the bight, or middle; and, therefore, only one-half of the length of its fibre is extended in the yarn; consequently, some qualities of hemp have hitherto been considered inferior, because, on account of the shortness of their fibre, they would not admit of being doubled. Now, Mr. Lang's plan has this additional advantage, that the hemp is spun by the end of the fibre, and thus, by having its whole length extended in the yarn, those qualities of hemp hitherto considered inferior, because shorter, may be applied with equal safety and advantage, and do in reality produce cordage as strong and as durable as the others. Indeed, the average length of what is termed staple hemp, when spun from the bight, may be estimated at about twenty-seven inches; whereas the average of the pass, or short hemp, by having its whole length extended, is about thirty-five or thirty-six inches; if, therefore, length of fibre is essential to the tenacity of the yarns, the new system has the decided advantage.

Such are the principles of Mr. Lang's invention; and as it produces a superior article, and at a cheaper rate than the competitors in the trade can supply it, it is evidently entitled to patronage. We regret, however, to find that the proprie-

tors have to complain of detraction and wilful misrepresentation; but we think the statements made by them are fully substantiated, both by actual experiment, and by the testimony of many unimpeachable individuals who have used the patent cordage. The question, of course, turns upon the two essential properties of ropes, which are strength and durability. To ascertain the former, reference has been made to immediate proof by experiment; and the tables which Macnab and Company have inserted in their exposition of the comparative trials under different circumstances show a triumphant balance in favor of the patent spun hemp. In forming a judgment of the other quality, a considerable time must necessarily elapse before all the various contingencies of climate and treatment can be examined. At the same time, it will be admitted, that the strongest cordage must, in the nature of things, be the more lasting. The tear and wear of a rope are properties absolutely inseparable; its strength must depend on the soundness of its material, and on its construction; and in proportion as these effect its strength, so must they also its durability.

These are grounds upon which Macnab and Company vindicate the patent cordage; and we think the impartial seaman, who peruses their pamplet, will rise well satisfied with their conclusions.

[For the Mechanics' Magazine.]

MEASURING DISTANCES.

1st. Wishing to know the distance from A to B, (fig. 1,) place a picket at B, and another at C, at a few fathoms distant, making ABC a right angle, and divide B C into 4, 5, or any number of equal parts; make another similar at C, in a direction from the object, and walk along the line CD till you bring yourself in a line with the object A, and any of the divisions, (say *o*,) of the line BC; then C *o* : CD : : B *o* : BA.

Fig. 1.

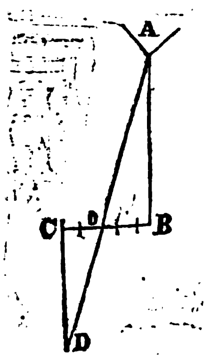
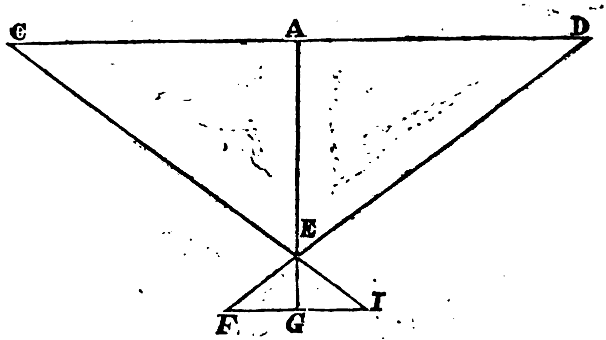


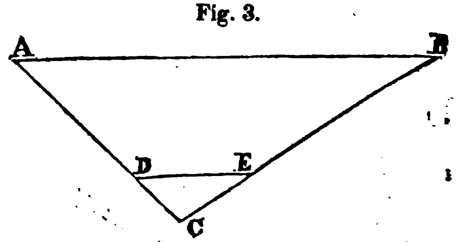
Fig. 2.



2d. To gain the distance between C and D, (fig. 2,) from any point A, taken in the line CD, erect the perpendicular AE, on which set off from A to E 1 or 200 feet, more or less, according to the distance between the points C and D; set off from E to G in the prolongation AE, $\frac{1}{5}$ or $\frac{1}{10}$ of AE; at G raise the perpendicular GF, and produce it towards T; plant pickets at E and G, then move with another, on GF, till it comes in a line with E and D; and on the prolongation of the perpendicular FG, place another picket at I, in a line with E and C; measure FI, and it will be as GE : AE : : FI : CD.

3d. To gain the inaccessible length AB, (fig. 3,) plant a picket at C, from whence both points may be seen; find the lengths CA and CB, by the method first given, (No. 1,) make CE $\frac{1}{4}$, or any part of CB, and

Fig. 3.



make CD bear the same proportion to CA, measure DE, and it will be as CD : DE : : CA : AB.

NOTE. Nearly after the same manner may be ascertained the distance from A to B, (fig. 3,) when the point B is accessible; having measured the line CB, and made the angle CED equal to CBA, it will then stand thus: as CE : DE : : CB : BA.

S. A.

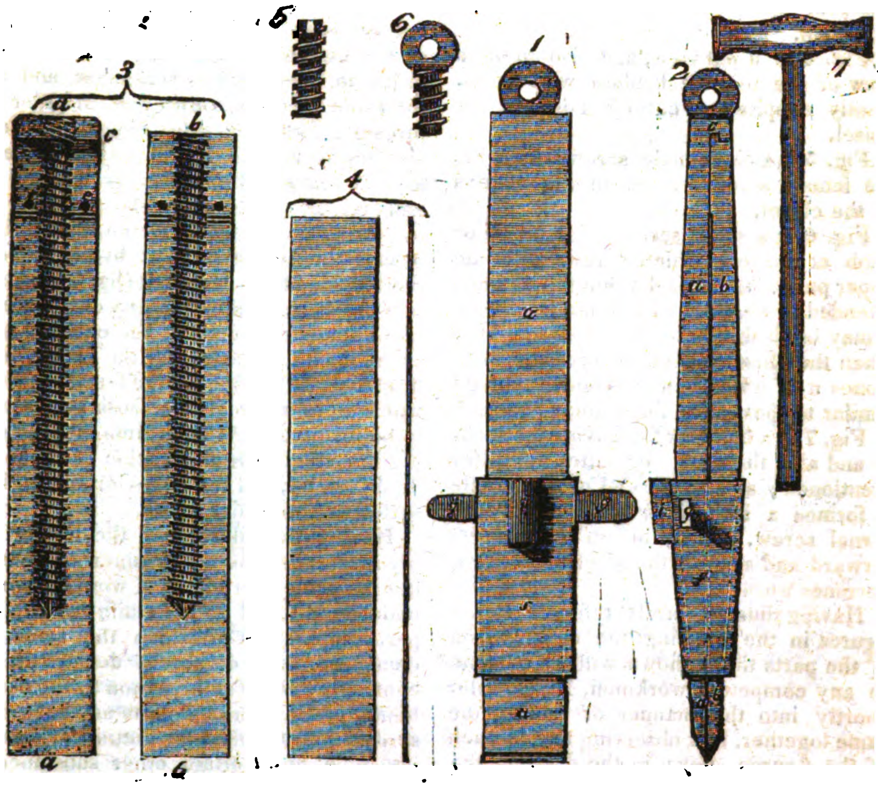
MECHANICS' MAGAZINE,

AND

REGISTER OF INVENTIONS AND IMPROVEMENTS.

VOLUME VI.] SEPTEMBER, 1835. [NUMBER 3.

SMITH'S IMPROVED CHISEL FOR CUTTING OR DRESSING STONE, ETC.



[From the Repertory of Patent Inventions, &c.]

Specification of the Patent granted to JOHN SMITH, *for a certain Improvement on Chisels or Instruments for cutting or dressing Stone, and certain other Substances.* Sealed December 23, 1834.

In ordinary millstone chisels, and also in chisels for cutting, dressing, or working other stone, and also for dressing cast iron, it is well known that the cutting edges quickly become worn, and consequently constantly require sharpening, which operation is performed by heating the same and forging such cutting edges to the degree of sharpness required; the operation of tempering is then to be performed; all which requires much time and judgment, and in places distant from a forge becomes a matter of considerable consequence. Now, the object of my invention is to use a thin plate of steel, properly tempered, which being supported on either side by cheeks, such steel plate, (as it becomes worn,) being capable of movement in order that a sufficient quantity for the cutting edge shall project beyond the ends of the cheeks, yet such thin steel plate, when in use, is

rigidly held between the two cheeks, and prevented receding from its work by a screw, whereby the whole, when combined, will produce a strong and highly useful chisel, as will be hereafter more clearly described.

Fig. 1 represents the side view of a chisel constructed according to my invention.

Fig. 2 an edge view thereof.

Fig. 3 represents the two cheeks, which I usually construct of iron and case-harden them.

Fig. 4 is a flat view, and also an edge view of the thin steel plate which constantly supplies a cutting edge to the chisel.

Fig. 5 is a short male screw which fits the female screw formed in the cheeks of the chisel.

Fig. 6 is a small screw, with a ball or knob at the top, which screws into the upper part of the chisel when the same is intended to be used with a mallet. And it may be desirable here to remark, that when the chisel is used for dressing mill-stones it is affixed in a wooden handle similar to those used for ordinary chisels.

Fig. 7 is a hammer for driving the socket and also the wedge or cotter hereafter mentioned; and on the end of the handle is formed a key for screwing up the internal screw, fig. 5, in order to press forward and support the steel blade as it becomes worn.

Having thus generally referred to the figures in the drawing, the construction of the parts there shown will be evident to any competent workmen, I will enter shortly into the manner of putting the same together, first observing that in each of the figures shown in the drawing the same letters of reference indicate similar parts. *a* and *b* are the two cheeks which constitute the main frame of the chisel; these cheeks go together by means of the mortice, *e*, and the studs, *e*, *e*, which latter into recesses formed in the cheek, *b*, as will be evident on inspecting the various figures. The thin steel plate is next inserted between the two cheeks, *a*, and *b*, the socket, *f*, is then to be placed on the end of the cheeks of the chisel, which being wedge form, the driving up of the socket will cause the same to bind more closely on the steel plate between them, and hold the same rigidly, and thus prevent lateral spring. It should be remarked, that on the cheek, *a*, is formed a groove, and in the socket, *f*, are two openings through which the wedge or cotter, *g*, is inserted and driven, by which the whole of the parts are securely held together. The screw, fig. 5, is to be screwed up within the female screw, in order to press against the other end of the steel plate, to assist in preventing its receding from its work. In using a chisel so constructed, the steel plate which constitutes the cutting edge will only require occasionally to be rubbed or ground on a stone in order to improve the sharpness, and as the same becomes worn away, in order to project a further quantity beyond the end of the cheeks, *a*, *b*, it will only be necessary to remove the wedge or cotter, *g*, and slide down the socket by giving it a few blows on the knob, *i*, the screw, fig. 5, may then be screwed up by the key on the handle of the hammer (fig. 7), which will project a further quantity of the steel plate below the ends of the cheeks, and such will be the case till the screw, fig. 5, arrives at the end of the female screw, when there will require a fresh steel plate to be inserted. At each time of projecting the steel plate the socket is again to be driven up, and the cotter or wedge inserted as before described.

Having thus described the nature of my invention, and the manner of carrying the same into effect, I would have it understood that I do not claim any of the parts separately of which the same is composed, but I do hereby declare that I confine my claim of invention to the combining of the various parts as above described into a chisel for cutting or dressing stone, and certain other substances, whereby I am enabled to use a thin plate of steel as the cutting edge, which may from time to time, as it becomes worn, be projected forward and offer fresh quantities for use, and yet, when in use, be rigidly held between the two cheeks, and prevented receding by the male screw, as above described.

Enrolled Feb. 23, 1835.

[From the London Mechanics' Magazine.]

HUNTER'S STONE-PLANING MACHINE.

In March last, a patent was granted to Mr. James Hunter, of Leys Mill, Arbroath, "for certain improvements in the

art of cutting, or what is commonly called facing and dressing certain kinds of stone." The specification of Mr. Hunter's method has not yet been enrolled; but from a Report, with a copy of which we have been favored, made to the proprietor of the Leys Mill Quarries, (W. F. L. Carnegie, Esq.,) by Messrs. Carmichael and Kerr, engineers, of Dundee, who were invited to see the method in actual operation at these quarries, and to verify the results, it appears to be immensely superior to any other hitherto devised. Mr. Hunter has seemingly realized that great desideratum, a power-machine for the cutting and dressing of stone, capable of withstanding the extraordinary friction to which it must necessarily be subjected. The despatch with which immense blocks of stone are cut up and dressed, by Mr. Hunter's apparatus, is prodigious; yet the cost of tools is next to nothing—"only a half-pennyworth of steel for every hundred feet of planed surface!"

Report of Mr. Charles Carmichael and Mr. John Kerr, Engineers, Dundee, on the power of Mr. James Hunter's Stone-planing Machine.

Sir,—Agreeably to your desire, we have visited Leys Mill Quarries, and attended minutely to the performance of the stone-planing machines. These machines do their work most effectually, as the following experiments, which we witnessed, will testify.

Experiment First.

We went to one of the machines that had six stones laid on the bench, one of which was planed, and the second begun to be operated upon; while this was doing, we took the dimensions of the other four, stones, viz.:

Number of Stones.	Length of Stones.		Breadth of Stones.		Thickness.	Finished Thickness.	Quantity taken off.
	ft	*in.*	*ft.*	*in.*	*inches.*	*inches.*	*inches.*
1	5	3	2	6	3½	2½	1
2	5	0	2	8	3	2⅜	⅝
3	5	6	2	6	6	4¼	1¾
4	4	0	2	3	4	2½	1½

The average thicknesses of the above stones are given, but many parts of them were much more than the thickness stated. One of the broad finishing tools was blunted ere the experiment began, and was changed when No. 2 was in the operation of being planed. No. 3 was a very hard stone, and was what is technically called yolk, in planing which one of the roughing tools broke at the point; still it wrought out the stone, and was then replaced. A splinter came off the face of the last stone, when about half finished, which was another cause of delay, as they had to go over it again; but, notwithstanding the delay occasioned by the breaking of one tool, by another being changed, and by having to go over the one half of the last stone twice, yet the time altogether was forty-five minutes, being at the rate of sixty-five superficial feet per hour.

Experiment Second (same machine.)

Five stones were now put on the planing machine, of the following dimensions, viz.:

Number of Stones.	Length of Stones.		Breadth of Stones.		Thickness.	Finished Thickness.	Quantity taken off.
	ft.	*in.*	*ft.*	*in.*	*inches.*	*inches.*	*inches.*
1	4	3	2	2	4¼	2¼	2
2	3	9	1	10	4¾	3¼	1½
3	3	4	2	8	6	4	2
4	3	6	2	0	6½	4¾	1¾
5	3	8	3	6	5½	4½	1

These stones were planed in forty-two minutes.

The above stones were taken from the quarries without selection, and the men that were working the machine were not informed of the object of our visit. Experiment first began at half-past twelve o'clock, noon, and experiment second was concluded at nine minutes past two; thus leaving twelve minutes for cleaning and reloading the bench of the machine. Had all the stones been 5½ feet long, they would have been planed in exactly the same time, for the machine travels the distance for that length; so that nearly sixty-seven feet of surface would have been planed in forty-two minutes.

The stones, as they come from the machine, are remarkably smooth and straight on the face; and were it not for the shade left by the tools, we would be apt to think them polished, as they feel as smooth as a polished stone.

We were told by the foreman, that during the last week there was planed* 4,400 superficial feet, more than half of which was planed on both sides, (indeed more than half of all the stone that leave

* See subjoined Note by Mr. Carnegie, on this point.

the quarry are planed on both sides,) by four machines. We saw the pay-list for the week: the amount was £6 1 6

the week: the amount was	£6 1 6
Add blacksmith for dressing and grinding tools,	12 0
	£6 13 6

We were further informed by the manager, that during the last summer there were upwards of 100,000 feet of pavement planed by four machines; and there was one thing that struck us most forcibly, which is the small degree of wear on the tools. Three shillings a week, or sixpence per day, is the cost of the labor for dressing and grinding the tools of one machine; and the whole consumption of steel during the last year was under a hundred weight, so that, if we measure both sides of those stones that were actually planed on the two sides, it will be seen a pound of steel will plane 1,500 feet, or about a half-pennyworth of steel for every 100 feet of planed surfaces.

There are now five machines working in the quarry, wrought by a steam engine of six-horse power, the steam cylinder of which is sixteen inches diameter, stroke two feet. Besides the machines, the engine has to work two inclined planes, one of which is for dragging up the pavement from the quarry to the machines; the distance on the incline 48 feet, ascent 1 foot in 5; average quantity about thirty tons per day of ten hours.

The second incline is for dragging up the rubbish from the quarry to the place where it is deposited; distance 87 feet, ascent 1 foot in 4; quantity from 50 to 60 tons per day of ten hours.

The above shows what the engine is actually doing; and we have no hesitation in saying that the engine would work eight machines besides the inclines without being overloaded; and our opinion is that a machine, on the average, is not much more than one-half-horse power.

We are, Sir, your most ob't serv'ts,

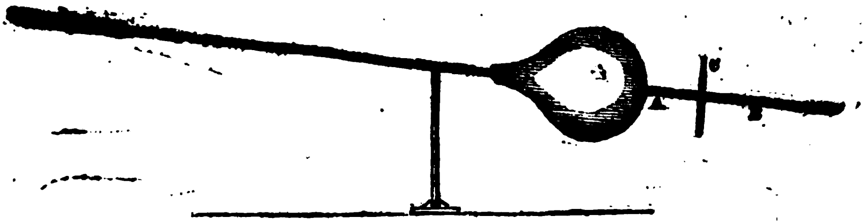
C. Carmichael,
John Kerr.

To W. F. L. Carnegie, Esq., Kimblethmont, Arbroath.

Note by Mr. Carnegie.

To explain the difference which is apparent between the quantities of planed stone, which, according to the statement of the engineers, *might* be produced in a given time by the machines, and the quantity stated to them as in one week actually sent to market, it is necessary to remark,—1st, That it is found in practice to be cheaper to dress the stones by the machine in the rough state and shapeless form in which they are taken from the quarry, and to square them by hand afterwards, than to follow the opposite course, as is done where the whole work has to be performed by hand; thus a great quantity of work measured by the engineers, but not available in the market, is nearly lost. 2d, A considerable quantity is required to be dressed over twice on one side, or on both sides, according to circumstances; thus the stones, No. 3, in Exp. 1, and Nos. 2, 3, 4, 5, in Exp. 2, being too thick, were redressed on the under side to suit the market. 3d, The quarry does not always afford stones of a size to fill the benches, when much power is lost, as the machine has to traverse the whole width. 4th, Other circumstances, (such as bad weather, &c. &c.,) which will readily present themselves to the minds of those conversant in these matters, always occur to prevent general results from attaining the extreme limit, which may be calculated as possible from the data of a short experiment. Mr. L. C. having been present, can confidently testify as to the correctness and impartiality with which these experiments were conducted, and to the truth of the information furnished to the engineers, by those in his employment.

Steam Engines in Glasgow.—To such an extent is the business of steam engine making now carried on here, that there are thirteen firms engaged in it. Some of the works are more like national than private undertakings. Three houses alone employ upwards of a thousand persons. Dr. Cleland has ascertained that in Glasgow and its suburbs there are thirty-one different kinds of manufactures where steam engines are used, and that in these, and in the collieries, quarries, and steamboats, there are 355 steam engines, equal to 7,366 horse power—average power of engines rather more than 20 horse each.—[Ency. Britt., 7th edition.]



[From the Repertory of Patent Inventions, &c.]

Specification of the Patent granted to Jas. *and* John Hartley, *for a certain Improvement or certain Improvements in the Manufacture of Glass.* Sealed October 22, 1834.

Our invention relates to part of the process employed in the manufacture of that description of glass called crown glass, used for the purpose of glazing windows and other purposes. It is well known that this description of glass is produced from the metal by blowing the same into the form of globes, and afterwards, by means of the operation called "*flashing*," such globes are thrown open into flat circular plates called tables. Now, our invention relates to that part of the process of manufacture which consists in blowing the metal into globes. According to the ordinary process, the metal when taken from the pot by the pipe is rolled on a smooth iron surface, in order to bring the outer end of the metal to a conical form, the extreme end of which becomes the outer axis of the globe during the operation of blowing and working the glass into the required form. This outer axis is called the bullion. During the expanding of the metal into the globular form, the workman rolls the bullion along a straight edge, or bar, called the bullion bar, as is well understood. In doing this, the outer end of the glass globe, whilst expanding, and continually revolving, rubs against the bullion bar, by which action parts of the surface of glass is disturbed or made irregular, and as the globe extends in dimensions this rubbed surface enlarges: the consequence is that when the table of glass is complete, there are at all times more or less waved lines for some inches around the bullion or the centre of the table of glass, which lessens the value of so much of the table. This prejudicial appearance is produced to the glass as before stated by that part of the surface coming in contact with, and rubbing against, the bullion bar, when the metal is in a soft and pliant state. Now, the object of our invention is to dispense with the bullion bar, and to supply its place by the application of a tube or hollow bearing for the bullion or outer axis of the globe of glass during the expansion of the same: by this means that part of the surface which was heretofore rubbed against the bullion bar, is, when worked according to our invention, in no way prejudicially acted on, and the waved appearance before consequent on the manner of operating is avoided.

The drawing represents an ordinary pipe with a globe of glass, the bullion, *a*, being supported by the tube, *b*, in which it is caused to revolve by the workman when working the metal into the globular form desired during its expansion. On the tube *b* is placed a shield, *c*, which is intended to prevent the heat coming from the heated glass, injuring the hands of the boy who holds the tube. The workman, in performing this part of the process of manufacturing glass, takes a proper quantity of metal on the end of the pipe, and proceeds to form the outer end of such metal into a cone; he proceeds with the process in like manner to that heretofore pursued till the globe of glass requires support at the outer end by its axis or bullion, *a*, that is to say, he proceeds in the ordinary manner up to the period at which (according to the old means of operating) the bullion would have been rested on, and revolved, and run along the bullion bar, but in place of so running it along the bullion bar, a boy holds the tube or hollow bearing, *b*, in such manner as to receive the bullion, *a*, and the workman causes the globe to revolve till the globe is sufficiently expanded. The same is then to undergo the operation of flashing as heretofore.

Having thus described the nature of our invention, and the manner of carrying the same into effect, we would have it under-

stood that our invention consists in the application of the tube or hollow axis, *b*, in place of running the bullion along the straight edge, called the bullion bar, as above described.

Enrolled April 22, 1835.

Avery's Rotary Engine.—After a long and vexatious, and yet unavoidable delay, we are enabled to give a drawing of Avery's Rotary Engine, of which we have frequently spoken before. The annexed drawing is taken from a *two*-horse power engine, built for this office, to drive a printing machine, which prints both sides of the sheet before it leaves the press. This engine, as it will be seen, together with the boiler, force pump, and governor, and, in short, *every thing necessary* for communicating motion to them and to the machinery to be operated, occupies a very small space, it being only 4 feet 8, by 2 feet 10 inches. The boiler is 17 inches in diameter, and 78 inches high; the furnace for anthracite coal occupying about one fifth part of it.

The principal advantages of this engine, as we conceive, consists in its compactness, the ease with which it is managed by any person who can tend the *fire*, the trifling cost of fuel, as well as the small outlay for the engine. The most important advantage, however, for many purposes, and especially for driving *printing machines*, will be found in its perfectly uniform motion. It is indeed so perfect, and the velocity so great, being about *five thousand* revolutions of the arm, shaft, and of course pulley on which the band runs, per minute, that but for other than the ordinary machinery attached to the engine, a casual observer would scarcely know that a steam engine was in operation.

In No. 12, vol. iv., of the Railroad Journal, is published an account of the performance of an engine used by the proprietors, Messrs. E. Lynds & Son, in their shop at Syracuse, New-York, which has now been in use more than two years, and we cannot do better than to re-publish a part of that article.

"The following extract refers to an engine with 10 inch arms, of 6 horse power, but the engraving given herewith represents one with 12 inch arms, or about 6 horse power. There is one now in operation in this city for sawing mahogany, with 2½ feet arms, which will do the work of a 12 or 15 horse power engine, and performs to the entire satisfaction of those who use it.

"The engine, that is, the shaft and arms, weigh, as I learn, only 15 lbs.; the arms, from centre of shaft to their ends, are 18 inches, and in their revolutions describe a circle of 9 feet 5 inches in circumference; the two apertures at the end of the arms are equal to the eighth part of a superficial inch, and under a pressure of 80 lbs. to the square inch, will balance a weight of 10 lbs. From some experiments made, it is estimated to carry a load of 8 lbs. through a space of 37,666 feet per minute. The boiler has 66 feet surface exposed to the fire, and consumes daily half a cord of soft dry wood.

There are in the establishment the following machines in operation, namely, 2 large engine lathes; 2 small do. do.; 2 hand lathes; 1 boring mill for boring cylinders; 2 drilling lathes; 1 grindstone; 1 mill for grinding coal; 2 bellows, 40 double strokes each per minute, which will force 560 cubic feet of air per minute, under a pressure of 1½ lbs. per square inch, and requires 4 to 5 horse power to perform its operation of melting 1500 lbs. of iron per hour."

The following references will give an idea of the engine; to examine it, however, will be more satisfactory.

A, the boiler, 17 inches in diameter, and 78 inches high, standing on a cast iron frame, with a grate inside.

B, the steam pipe, which conducts the steam to the end of the shaft C C, one end of which is enclosed in a superfluous cast iron tube. The steam is ordinarily conducted from the boiler to the end of the shaft in a simple steam pipe, which may be six inches, or 6 or 12 feet in length, to accommodate the engine to the machinery, without regard to the position of the boiler.

C C, the shaft passing through the case D, and the arms Q, Q, fig. 2, which are enclosed, and revolve in the case D. On this shaft, as will be seen in fig. 2, is the pulley E, from which the band passes to the machinery.

D, a circular cast iron case, in two parts, fitted and put together with bolts, and made steam tight. This case has in some instances been made of sheet iron; cast iron, however, is deemed best. The case, el-

Avery's Rotary Engine.

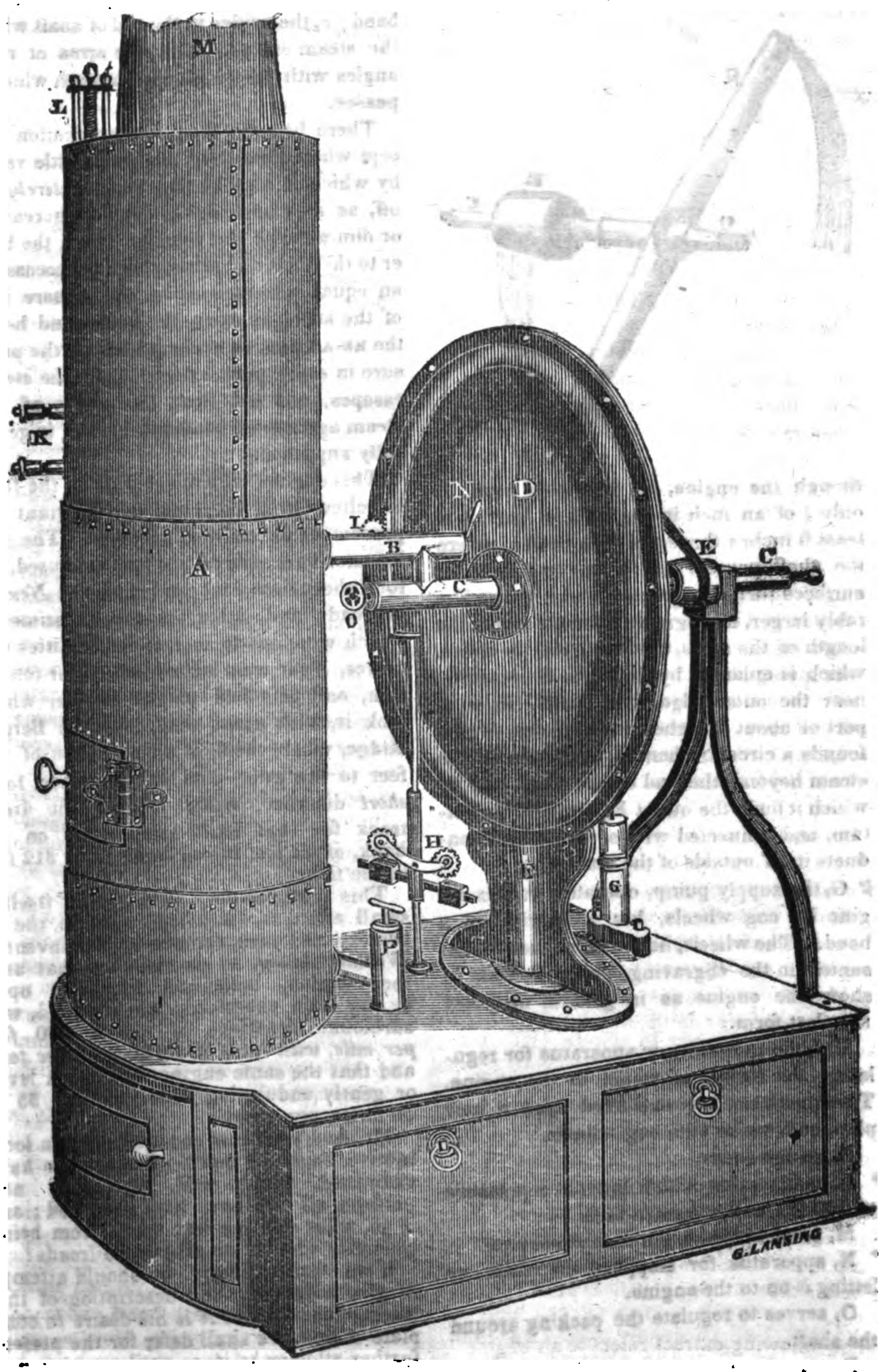


Fig. 2.

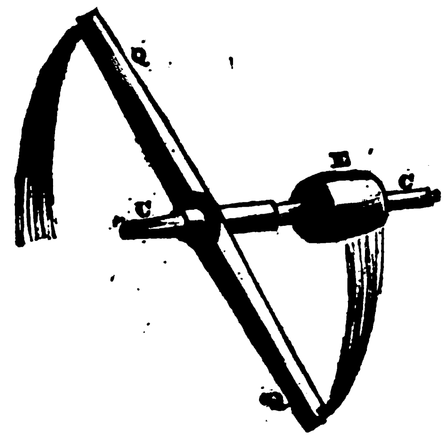


Fig. 2.—C C, shaft; E, pulley for the band; *r*, the orifice in the end of shaft where the steam enters; Q Q, the arms at right angles with the shaft, and through which it passes.

There being a free communication (except when obstructed by the throttle valve, by which it may be *in part, or entirely* cut off, as may be desired, thereby increasing or diminishing the velocity,) from the boiler to the shaft and arms, there is necessarily an equal pressure upon the square inch of the arms, as upon the boiler, and hence the RE-ACTION, in consequence of the pressure in every part, except where the steam escapes, and not from the action of the steam against the atmosphere, as is generally supposed.

though the engine, or revolving arm, is only $\frac{3}{4}$ of an inch in the thickest part, is at least 5 inches through in the centre, where the shaft passes, having the two concave surfaces turned together; and it is considerably larger, or of greater diameter, than the length of the arms, that there may be space, which is enlarged by giving to the casting, near the outer edge, a half circle in each part of about 3 inches in diameter, which founds a circular channel or groove for the steam beyond the end of the arm, and by which it finds the outlet F, through the bottom, and connected with a pipe which conducts it off outside of the building.

G, the supply pump, operated in this engine by cog wheels, but ordinarily by a band. The wheels, however, are not represented in the engraving, being desirous to show the engine as in general use, and simplest form.

H, I, the governor, or apparatus for regulating the supply of steam to the engine. This regulator is constructed upon a new plan, and works with cog wheels.

K, gauge cocks.

L, safety valve, which is set at a pressure of 100 lbs. to the square inch.

M, smoke pipe—a six inch stove pipe.

N, apparatus for stopping the steam, or letting it on to the engine.

O, serves to regulate the packing around the shaft.

P, water supply pipe.

This engine, we are yet fully in the faith to believe, will be found an important improvement for *railroad purposes.* The only locomotive engine of the kind ever used, run for a short time, last spring, on the *Newark* railroad; and, after various experiments, which were made to test its qualities and power, a car was loaded with four tons of iron, and attached to the engine, which took it, with great ease, over the Bergen Ridge, where there is an elevation of 152 feet to the mile—and in one place, for a *short* distance, when leaving the direct track for that built temporarily on the bank, *of six feet in one hundred*, or 312 feet to the mile.

This performance, although in itself a small affair, is, knowing, as we do, the ingenuity and perseverance of the inventor, *William Avery*, to us evidence that another engine, built and improved upon by the little experience already had, will surmount elevations of *150 to 200 feet per mile, with loads of eight to twelve tons*, and that the same engine will, on a level, or gently undulating road, perform 35 to 50 miles per hour.

Mr. Avery is now engaged upon a locomotive engine, a model of which we have examined, which will, we doubt not, perform all we have here predicted; and if so, what can prevent them from being generally adopted on all our Railroads?

If we were at liberty, we should attempt to give a drawing and description of this locomotive; but, as it is his desire to complete it first, we shall defer for the present further allusion to it, or until we have permission to give a definite account of it.

[From the London Mechanics' Magazine.]

ADAMS' CIRCULAR SPRING WHEELS.

"Break all the spokes, * * * * *
And bowl the round nave down."

It has long been a desideratum amongst mechanicians, to accomplish the task of constructing a wheel for carriages intended to convey persons and goods over rough roads, which, while it should possess sufficient strength fitly disposed in its several parts to resist breakage, unsteadiness, or any permanent alteration of form, from any of the ordinary shocks or violence to which it might be subjected, should yet possess the property of elasticity to such a degree, as to intercept and materially diminish the concussion caused by the periphery rolling over obstacles during its revolution; and thus either prevent the concussion from extending its effects to the axis round which the wheel might revolve, or to lessen it so much that the effects might be comparatively innocuous. It must, of course, be necessary that the elastic power should be placed between the periphery and the axis, without in any way diminishing the roundness or altering the circular form of the periphery—which circumstance would tend materially to increase the rolling friction of the wheel: wherefore the only mode in which elasticity can be made available, must be by enabling the axis to depart sufficiently from the exact centre of the periphery where concussion takes place—to which exact centre the elastic force, pressing equally in various opposite directions in the plane of the wheel, should have a constant tendency to restore it when the effect of the concussion might cease. The advantages attendant upon a wheel so constructed are several and obvious.

1st, In ordinary sized wheels, used for a cart without springs, the concussion from the road is driven in a direct line along the spokes of the axis; and this concussion, constantly kept up as the wheel revolves, serves materially to increase the weight of draught, by forcing out the oil or grease, and bringing the rubbing surfaces of the axis and axis-box in close contact, to the increase of friction. This disadvantage would be removed entirely, or very materially lessened, by the use of an elastic wheel.

2d, In carriages with rigid wheels, to which the axis is attached by means of a horizontal spring bearing on the axis, the concussion is diminished, by its uniform bearing upwards; still it is but slightly, inasmuch as the momentum of the concussion passes directly along the rigid spokes to the axis; and, moreover, the relief which the spring affords is only in a vertical direction; in which direction the greatest amount of the momentum of concussion does not pass, but in a direction more inclining towards the line of progress as the wheel revolves. This disadvantage would be materially lessened by an efficient elastic wheel, inasmuch as the elasticity being in a circle all round the axis, would avail both against vertical and horizontal obstacles or inequalities.

3d, It is well known that the force requisite to move a carriage at first starting is greater than that required to keep motion up. The reason of this is, that momentum is required in proportion to the rapidity of the motion. Wherefore, every obstacle or inequality which the wheel encounters as it revolves, has a tendency to check the momentum, and render the draught power necessary to move the carriage onwards nearer in amount to that which was originally required to move it from a state of rest; because the concussion in the line of progress is nearly in direct opposition to the momentum, and serves to neutralize it. An efficient elastic wheel would be found to receive the concussion on its periphery, but as it would not carry it, or would carry it with a diminished force, to the axis, the momentum of the superincumbent framework, to which the draught power is attached, would scarcely be acted on by it.

4th, The wheels of carriages are subject to considerable concussion in a lateral direction, lengthwise of the axis. A rigid wheel, under such concussion, transmits the concussion almost unbroken to the carriage, to the annoyance of the passengers, and with a tendency to derange the framework. But an efficient elastic wheel would possess a small portion of lateral elasticity, sufficient to diminish the violence of the concussion, and yield greater ease of motion.

5th, An elastic wheel, by its tendency to elude concussion rather than to resist it, will be less liable to be broken or

strained than one which is rigid, and consequently its total durability is likely to be much greater. Wooden wheels, by reason of their property of elasticity, are less liable to break than those of iron.

Wheels are to a carriage what legs are to a human being—the instruments of locomotion. A man who loses an elastic leg, of bone, muscle, and ligaments, may have a wooden one to replace it; but he will find that the act of walking with the wooden one is a much ruder and less perfect process than with the one of bone and muscle; concussion, and the labor of surmounting or avoiding obstacles, will render the man's progress much slower. And it seems clear, that the property of elasticity in a wheel gives it a similar advantage over a rigid one that the natural leg does over the artificial one, though to a less extent; inasmuch as the mechanical contrivance of art must be inferior to the more perfect processes of nature. Ships, which are of rigid construction, are found to make a slower progress through the water than such as are slightly flexible; and in row-boats, the quality of flexibility is indispensable to swiftness: the reason is, that the flexible boat, as it advances, adapts itself, by its sinuosity, to the slight movements and currents of the water, which it eludes instead of resisting. The movement of a fish through the water is an illustration of the same principle; and, by a parity of reasoning, a carriage with elastic wheels avoids, by its yielding properties, many obstacles over which rigid wheels would require to be impelled by a greater exertion of power.

The general conviction of the advantages to be obtained by using elastic wheels has led to many attempts at their construction, but hitherto without any efficient result. One mode which was attempted was by arranging a number of pointed double elliptic steel springs in radiating lines from a nave to a periphery. To guard against the lateral action or leverage, these springs were doubled in number, and arranged at a lateral angle with the length of the nave each way. Even supposing such a wheel to be efficient, the expense of its manufacture would have precluded any extensive use of it; but the action was too imperfect, to allow much use without destruction of its parts. The elasticity of the springs could only be brought into action in the direction of the length of the ellipses, either by extension or compression; consequently the action could only be in a line diametrically across the wheel in one direction at a time: thus but few of the springs would be in action at one time, and that in a most imperfect mode, viz., in the length of a very long and narrow ellipse. The principle of an efficient spring wheel should be, that the elasticity should be alike at all parts of the circumference, and that no one part should act without the whole—that every spring should sympathise equally with the rest, from whatever direction a concussion might come. A wheel like that just described could not comply with this condition, and therefore such a wheel could not be durable. Another mode of forming a spring wheel was by making steel blades or ribbands in a sinuous or undulating curve, and forming them in radiating lines from a nave to a periphery, doubling them in the same manner as described in the elliptic spring wheel, to resist the lateral action or leverage. Supposing this wheel to be true and well made, the action would be more perfect than the former one; but the making of such springs all to stand their work equally well, and the needful accuracy of fixing them, would involve an expense too great for any extensive use; and after all, the action would be of that kind very likely to break the springs with a violent concussion. A third plan which has been proposed, but, we believe, never put in practice, is a small wheel placed within the circumference of a solid rigid ring of much larger diameter, the space between being supplied with several small hoops of ribband steel with open ends, put in with compression, so as to leave them free to enlarge or diminish their diameter when in action. These hoops were to be kept in their places by flanged segmental cavities adapted to their size in both wheel and ring, being otherwise unconfined by any fastening. The disadvantages of this form of wheel are many. First, its extreme want of elastic firmness; next, its want of universal action, being calculated only to act by compression on the springs below, and not by extension of the springs above. A great

defect would be, that while the weight were pressing on the lower springs, the elastic action of the upper springs would be directed, not to alleviate, but to increase the weight. In action, this wheel would be impracticable; for stones and dirt would lodge in the centres with the springs, clog their action, and break them. But one useful thing they contain, viz., the germ of the only sort of spring which can be effectively applied to spring-wheels—the circle. The wheel itself is a circle continually revolving, and springs intended to have an equal action in that wheel, whatever side be uppermost, must be circles likewise. No other form can be of universal action, in the place of the wheel; no other form will yield extensibility and compressibility in every direction in rapid succession, each tending alike to restore the nave to the exact centre of the periphery, as the momentary action of concussion passes away.

Mr. William Adams, a partner in the firm of Hobson and Co., of Long-acre, has marked this essential principle, and has had the perseverance to work it out in detail, so as to lay it before the public in a practicable form. The leading features of his invention are four hoops of broad steel plate, properly tempered, the ends of the hoops being overlapped and rivetted together, so that each hoop may be solid, by which means it will resist and yield equally, both by extension and compression. These hoops are affixed firmly at equal distances in the interior of a rigid circular rim, which forms the periphery of the wheel. This circular rim is made rigid by its peculiar mode of construction. An inner iron, or steel tire, of less substance than the outer one, is surrounded by a circle of wooden fellees, accurately fitted to the inner tire, and also with their ends accurately fitted to each other like a barrel arch, the lines of the joints meeting in the centre of the circle. Around this circle of fellees, so fitted, the outer tire is shrunk on hot, as usual, and all three thicknesses are rivetted together. In calling this a rigid rim, we do not mean that it is rigid like an iron casting, (for if it were so, it would not stand its work, but be liable to break, as cast iron wheels do,) but that, while it possesses a slight portion of elasticity sufficient to prevent breakage, it is also sufficiently strong to prevent any permanent alteration of its form by any ordinary concussion to which it may be subjected. To this rim the four hoop springs are firmly bolted, but do not in any material manner contribute to strengthen it. The springs serve as elastic legs; the rim serves as a foot to guide the steps they make in revolving. Wheelwrights call the act of putting a tire on a wheel, "shoeing it."

The nave of this wheel is made of iron flange plates, fitted to the axis-box, and reinforced by wood blockings. The flange plates are made in the form of a Maltese cross, and to the arms of this cross the hoop springs are firmly fixed, each with four clip bolts and nuts, without making holes in the spring; and this mode is found to ensure sufficient lateral strength to resist the central leverage of the wheel. The springs are tapered in width towards the circumference, in order to give the greatest elasticity towards the point of concussion. The axis-box is so contrived that it will carry a very large magazine of oil in actual contact with the axis, and the wheel is therefore likely to travel considerably farther without requiring fresh oil than any other kind, more especially as the elastic action removes the extra friction arising from concussion. Most oil axes are fed with oil by a capillary or pumping action. This action is liable to be disturbed from many causes, and if disturbed, the wheel will become fast on the axis by heating. But an axis in actual contact with the oil cannot be liable to these accidents.

One of the first considerations which struck us was, that a wheel with so much metal in it must necessarily be very heavy; but this proves not to be the fact. The peculiar action and combination of the springs being such that all mutually assist and are dependent on each other, the thickness of the plates is necessarily so much reduced below the ordinary standard of spring plates, that great lightness is combined with great strength. Thus a pair of these spring wheels are found to be just so much heavier than ordinary wooden ones as the weight of the inner tire amounts to. But as the axes used in ordinary rigid wheels are made much heavier than is needful for the weight they carry, in order to resist extraordi-

Fig. 1.

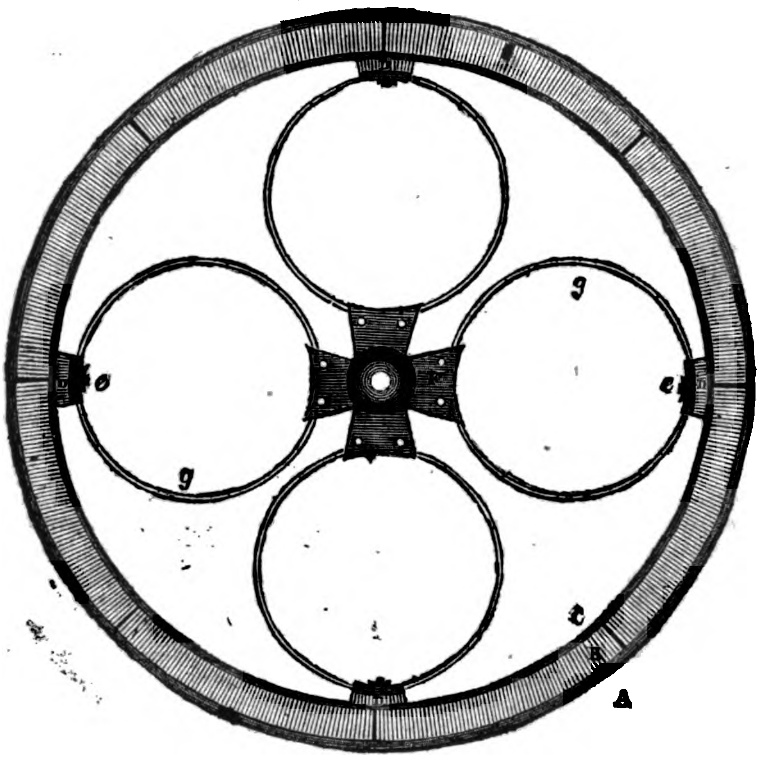


Fig. 2.

nary concussion, so the axis of the spring wheels, not being subject to the same amount of concussion, may be reduced in weight, in order partly to compensate for the tire; and the surplus weight being thus placed at the circumference of the wheel, instead of on the axis-bearing, the friction will be reduced: and, in addition to this, the freedom from concussion, consequent on the use of the elastic wheel, will enable a saving to be made in the weight and number of the carriage-body springs; and thus a farther amount of weight, and consequently of friction, will be removed from the axis-bearing. In the construction of a wheel-carriage, the weight, as well as the strength of the wheels, should always bear a certain proportion to the superincumbent weight, or the centre of gravity may be too high, a disadvantage nearly as great in a carriage as in a ship. A wheel may be too light as well as too heavy, and the former defect is the greatest. The former is a defect of principle, and is dangerous: the latter can only make a slight difference in the draught by additional weight, and not by additional friction on the axis-bearing; and, at a considerable speed, the weight of the heavy wheel acts with momentum like a fly-wheel.

Mr. Adams' elastic wheel is light and elegant in its appearance, and apparently well adapted for pleasure carriages on common roads; but there *is* a still more extensive purpose for *it* to serve—we allude to the railroads, whose increasing number and probable universality render economy in the mode of transport a most important object. It appears, from Mr. Wood's statements, that the difference of wear and tear between carriages with springs and carriages without, on railroads, is as one-quarter to one-half. The springs used in railroad carriages are very short, and have little play, and that only in a vertical line, which is not the line of concussion. At rapid speed, the necessity for elasticity increases in com-

pound progression. The speed used on railroads would tear a carriage to pieces on a common road. A small pebble, or a trifling inequality in the joint of a rail, at a high speed, gives a violent shock, and the momentum of each succeeding wheel, in a long train of carriages, like repeated rapid blows of a hammer, at each action increases the weakness of a loose rail, and ultimately breaks it, or renders it useless. As the elasticity of the spring-wheel acts in a direct line of concussion, both rails and carriages would be saved from it, and the total amount of friction considerably diminished. In the ordinary rigid wheels used on railroads there is occasionally a tendency, when not running in an exactly straight line, for the side of the flange which guides them to mount the rail, and thus overturn the carriage. It seems to us that the lateral elasticity of Mr. Adams' wheel would have a tendency to prevent this kind of accident; for the flange not revolving in a rigid plane, would slip downwards from the rail, as fast as a grinding contact might give it a tendency to mount, and the lateral elastic action would then tend to restore the track of the wheels to the proper position.

An elastic wheel possesses another advantage over a rigid one, in case of the defective construction incident to all wheels, viz., the absence of roundness, i. e. eccentricity of orbit. A rigid wheel of this form must necessarily move with much friction; but the elasticity of a spring-wheel would tend to correct this defect, by yielding where there was the necessity during its revolution.

For ordinary weights, the springs are made in single plates, by which means they may be effectually preserved from rust; but for heavy carriages and engines, the inventor proposes to multiply the number of plates in the same mode as other carriage springs.

Fig. 1 is a side elevation of the wheel. Fig. 2 is the cross section. A is the outer tire; B, the felloes; C, the inner tire; D, blocks to bend the springs on the rim; *e*, the clips to fix the blocks down the springs on the rim; F, the central Maltese cross and axis-box; *g*, the circular springs.

By the simplicity of construction, if a spring should break, it may be removed and re-placed, without taking a carriage off the road, in a few minutes. The railroad central nave is of still simpler construction than that for the common road.

FIVE HUNDRED DOLLARS PREMIUM.—The Directors of the City Hotel in Boston offer the handsome premium of five hundred dollars for the best plan for erecting an extensive Hotel, &c. on a site of ground containing 21,000 feet, directly opposite the passenger depot of the Worcester Railroad, in the South Cove. The plan, accompanied with drawings, to be presented to the Treasurer by the 15th September next.

New Hydrometer—Query.

To the Editor of the Mechanics' Magazine:

SIR,—In June, 1831, the notice now enclosed ran the rounds of all the London papers. It reads "a piece of metal," but what metal is not stated. May I request you to say in your next, whether zinc, platina, copper, or any other? If you are not aware which kind, please desire information in your valuable work.

Respectfully, your reader,

ASMODEUS.

July 18, 1835.

"A NEW HYDROMETER.—A new instrument to measure the degrees of moisture in the atmosphere, of which the following is a description, has been recently invented by M. Baptiste Lendi, of St. Gall. In a white flint bottle is suspended *a piece of metal* about the size of a hazel-nut, which not only looks extremely beautiful, and contributes to the ornament of a room, but likewise predicts every possible change of weather 12 or 14 hours before it occurs. As soon as the metal is suspended in the bottle with water, it begins to increase in bulk, and in 10 or 12 days forms an admirable pyramid, which resembles polished brass, and it undergoes several changes till it has attained its full dimensions. In rainy weather this pyramid is constantly covered with pearly drops of water; in case of thunder or hail, it will change to the finest red, and throw out rays; in case of wind or fog, it will appear dull and spotted; and pre-

viously to snow, it will look quite muddy. If placed in a moderate temperature, it will require no other trouble than to pour out a common tumbler full of water and put in the same quantity of fresh."

Any of our friends or correspondents who will solve this question, will much oblige.

Improved Draft of the Hull of a Steam-boat.

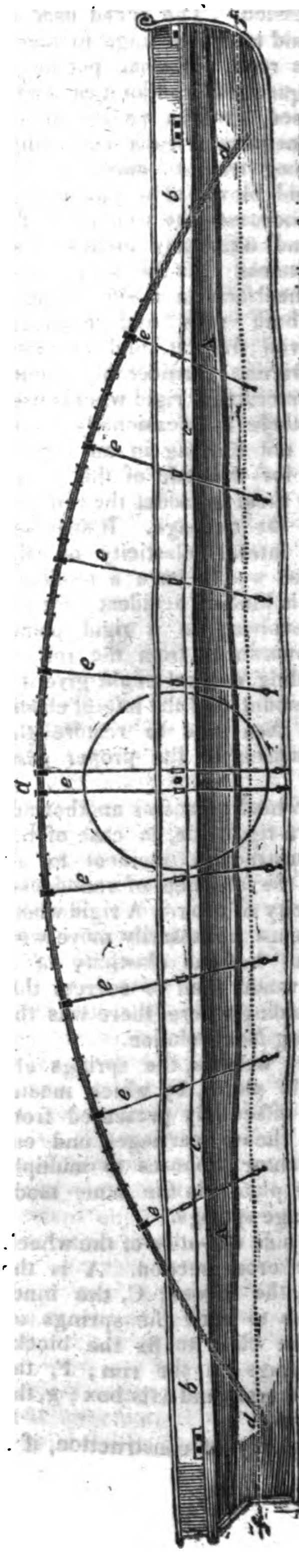
To the Editor of the Mechanics' Magazine:

SIR,—The favorable reception you gave an article of mine in your last number, has induced me to offer the annexed draft of the hull of a steamboat, with an *elevated* deck, and an *arched* or *semicircular bracing*, the objects of which are the more effectually to guard against the boat being thrown out of shape by the weight of the engine, boilers, &c., &c., and the depression of the bow and stern; or the necessity of building them with such heavy materials as to cause them to draw too much water for extreme speed, or the navigation of shallow waters; added to which, the raising of the deck in the centre (in this draft two feet) not only enables light and air to be more easily introduced to the cabins, but also brings the upper surface immediately under the water-wheel shafts, which both passengers and engineers must admit is a very desirable improvement.

I had prepared a full explanation of the draft according to my views, but upon deliberation concluded that, to those who are competent to judge of it, any explanation that I could give would be superfluous, preferring to defend its merits, if doubted, either in person or through the same medium this is given; at the same time, with all due deference, challenging a refutation of its advantages or origin, with the writer, although I am well aware that on the latter ground I shall be met with the fact, that two boats lately built are now running, each of which have improvements *somewhat* similar to the above, but it is no less a fact, that the design from which this draft is taken was made by me twenty-one months since, which can be duly substantiated by a

YOUNG MECHANIC.

Aug. 30, 1835.



A, A, the hull; *b*, *b*, the waistboards or bulwarks; *c*, *c*, the outer edge of the guard; *d*, *d*, *d*, the arched or semicircular bracing, consisting of six or more thicknesses of oak plank, 2 inches thick by 12 inches wide, fastened together by screw bolts and nuts, and firmly built in and bolted to the hull, at the extreme ends, supporting the boat by its connection with the kelsons, timbers, &c., with the wrought iron swivel screw bolts, *e*, *e*, *e*, *e*, converging to one common centre of a circle, of which the line, *d*, *d*, *d*, is an arc.

Note.—The dimensions and distances are not written, as the draft is drawn on a scale, viz., 25 feet to an inch.

[From the London Mechanics' Magazine.]

ANTIS' IMPROVED CHIMNEYS.

Sir,—If the following paper, abridged from *Hazard's Register of Pennsylvania*, will tend at all to a discontinuance of the revolting practice of employing climbing boys in chimneys, I shall be happy to see it in your valuable and instructive publication.

Yours faithfully, A. Z.

To construct a chimney which would carry smoke has been found in practice one of the most precarious objects of mechanism. So little has the theory of smoke and draft been understood, that if ever a chimney was constructed to draw well, it was evidently a matter of accident; for no mechanic seemed to have any rule for constructing chimneys which would ensure a good one. We have been extremely gratified within a few days, by the inspection of a flue, and a set of fireplaces, constructed upon a plan entirely new in principle, invented by Mr. Henry Antis. We had not the pleasure of seeing Mr. Antis' model; but we saw the practical effect of his discovery, by a chimney and fireplaces in operation, in the house of Mr. Joseph Wallace, in Front street, the success of which is complete, and triumphantly sustains Mr. Antis' theory on the subject. His theory is, that cold atmospheric air tends to the centre of gravity, till it meets with some obstruction, which gives it another direction; that heated or magnified air is exactly vertical in motion; that hence, the flue to carry it off should be perfectly vertical, and in no place of smaller dimensions than at the bottom or first inlet. He maintains that it matters not how many inlets there be to it, provided the area of a cross section of the flue be equal to those of all the inlets combined; it may be greater, but must never be smaller. He therefore starts with a single flue from the cellar, regulating the size to cover the area of all the contemplated inlets from bottom to top. He carries it up all the way of the same size, in exact perpendicular direction; nor need the wall be more than the width of one brick in thickness. Wherever he wants a fireplace, he attaches jambs of the usual shape, leaving the common perpendicular wall of the flue for a back, throwing an arch across at the proper place in the usual form, covering it tight to the back wall. Immediately opposite or below the covering of the arch, he leaves a horizontal aperture in the flue, the whole width of the fireplace, from jamb to jamb, in size according to calculation previously made, and according to the height of the arch, which, for jambs from twenty-four to thirty inches high, must not be less than three inches perpendicular in the opening.

There seems to be philosophy in this theory; and practice, so far as tried, proves that there is truth in it; and we have no doubt the plan will, on a little further trial, be universally adopted by builders.

Beneath each grate, fitted in a fireplace, is an opening left, which descends obliquely into the flue. In this opening, on a level with the hearth, is a fire grate fixed, through which the ashes descend from the grate above. And such is the effect, that while a strong current of air is produced by the heat from the fire in the grate, through the horizontal aperture above, a moderate draught is also maintained in the oblique one below, which carries off all the dust; so that from a coal fire not a particle of dust escapes into the room. He also affixes a valve to each inlet, hung in such an ingenious manner, that the mere pulling of a small brass knob closes it entirely; and thus, in case the chimney should take fire, all the currents of air may be stopped in a moment, and the fire dies at once. Not a particle of soot can ever enter your room or your fireplace; for that, as well as the ashes, all descend to the bottom of the flue in the cellar, where an opening, with a sheet iron door, is constructed, from which these articles can be taken, and through which a sweep may enter and perform his duties, without disturbing the business, or amusements, or quiet, of any part of the family. Where necessary, he also carries up side flues in the jambs, by which air can be introduced, to regulate the temperature of your room, or the force of your draughts.

The advantages of this improvement are,

1st. Fewer materials are used, which cheapens the work.

2d. Less room is engrossed by dead brickwork.

3d. No annoyances from soot or ashes in your rooms—not even when a sweep ascends to clean out your flue.

4th. Power to regulate the temperature of your rooms, without opening doors or windows.

5th. Perfect security against smoke in every room in your house.

New Description of Cabriolet.—A vehicle of this description, hung upon a new principle, has just been brought out at Paris, and is now all the rage there. Its advantages over the old one are greater lightness, easiness, and cheapness. The principal difference is in the mode of suspending the body. In the patent cab the square frame is dispensed with, and the substituted one may be best described by likening it to a hay fork, supposing the horse to work within the prongs, and the body to be built upon springs upon the handle, which is laid across the axletree. By the balancing of the body upon a single perch, the movements backward, forward, and laterally, are much easier, and the whole is rendered lighter. It of course requires good screwing at the point where all the springs radiate upon the beam of the scale, to maintain the body in its proper position, but as constructed it is said to answer well. The principle of resting bodies on a point in the middle, is not new in the construction of four-wheel carriages.—[London Morning Herald.]

[From the London Mechanics' Magazine.]

Bernhardt's Patent Warming and Ventilating Process.

Several indistinct notices have appeared in the newspaper press, both domestic and foreign, during the last twelve months, (and some, it must be confessed, of rather a high-colored description,) of a new mode of warming and ventilating, stated to have been discovered by Mr. Bernhardt, a Saxon architect of considerable eminence, and exemplified by him with extraordinary success in a number of public buildings on the continent. As Mr. Bernhardt has taken out a patent in this country for his invention, and the time for his specification has now nearly expired, we shall soon be enabled to lay the whole particulars of his plan before our readers; but, in the mean while, the following extracts from a statement authenticated by the signature of Professor Schaeffer, of Dusseldorf, may be accepted as good evidence that Mr. Bernhardt has actually arrived at some results of more than ordinary importance—one of which, at least, is, even in this country of high mechanical invention, still a great desideratum, namely, *smoke without soot*. A late distinguished physician (Sir George Tuthill) has left it on record as his deliberate opinion, that the excessive quantity of carbonaceous matter sent forth into the atmosphere of London from its innumerable coal fires is the grand cause of its unhealthiness, as compared with places in its near vicinity.

"The Royal General Post-Office built, many years ago, a factory adjoining the post-house, for the repair of the mail-coaches, and since the building of the diligences and the increase of business, it has become a very large coach manufactory, in which above seventy workmen are at present daily employed. In a building at the back, arranged for the purpose, a forge for ten fires was put up and erected in the usual form. Smoke and soot penetrated into the dwellings of the neighbors, and rendered them uninhabitable and worth no rent. Complaints arose, and an expensive law-suit, which naturally terminated to the disadvantage of the Post-Office department. Experiments were then made to clarify the smoke and separate the soot. The Prussian consul in England—that land of invention—was desired to make inquiries whether any means were known to remedy the evil, but nothing could be done; and the most learned professional men doubted the possibility of an invention to answer the purpose, because it was believed that any attempt to separate the smoke from the soot could only be made at the expense of the draught.

"It became a point of consequence, to the Post-Office authorities here, to satisfy the neighbors at any price, and they endeavored to suppress the nuisance arising from the soot by removing the smithy into an intermediate building constructed for the purpose: the result of experiments by several artists, in inventing an ap-

paratus by means of which it was hoped to banish the soot. A cistern of water was applied over the roof, which was intended, by being placed round the outlet for the smoke, to absorb its heavier parts; but the soot soon covered the water with an incrustation, and the finer particles of the soot escaped from the chimney and covered the gardens of the neighbors; besides the smoke spread itself throughout the smithies, so as to be dangerous and insupportable to the workmen at the fires. At that time the architect, Mr. Bernhardt, of Saxony, was in Berlin, and had been employed in the Royal Palaces; having devoted the whole of his life to the study of the deficiencies at present existing in the construction of fires, he was enabled to correct the similar faults in the General Post-office buildings, and his plans were crowned with the best success. Mr. Bernhardt discovered the means of forcing the draft of the smoke, and separating the soot from it. His plans were carried into execution. *In a short time, without any interruption to the business of the coach factory, the work was completed. The smoke ascends in a purified state through two cylinders of zinc to the roof, and the soot remains in the interior of the three story high building, concentrated in separate channels and chambers for it.*

"It is remarkable to observe the soot depositing itself in coarse particles, and afterwards becoming gradually finer as it ascends; to see the smoke rising through narrow wire nets. In the channels of the five chimneys a mass of $26\frac{2}{3}$ cubic feet of soot was found, after three months' purifying, and which had formerly been mostly conducted over the roof."

Benjamin Franklin and Dr. Mather, of Boston.—The following letter was written by Benjamin Franklin, in 1784, while he was discharging the duties of American Envoy at the court of France. It is so highly characteristic of the man, and so fraught with instruction, that, although it has been often republished before, it is deemed very suitable for the readers of the "Companion"—who will, we are sure, be always pleased to read the writings and sayings of that worthy and great man.

In the last paragraph but one, he speaks of the importance of cultivating kindly feelings between the two nations—a sentiment which has generally pervaded this country, at least so far as it could be done with honor. The closing paragraph contains advice equally applicable to individuals, as to the peculiar condition of this country at that period. Advice which every *young* man, at least, should strive to profit by.

Rev. Sir,—I received your kind letter, with your excellent advice to the people of the United States, which I read with great pleasure; and hope it will be duly regarded. Such writings, though they may be lightly passed over by many readers, yet, if they make a deep impression on one active mind in a hundred, the effects may be considerable.

Permit me to mention one little instance, which, though it relates to myself, will not be quite uninteresting to you. When I was a boy, I met with a book entitled, "Essays to do good," which, I think, was written by your father. It had been so little regarded by a former possessor, that several leaves of it were torn out: but the remainder gave me such a turn of thinking, as to have an influence on my conduct through life: for I have always set a greater value on the character of a doer of good, than any other kind of reputation: and if I have been, as you seem to think, a useful citizen, the public owes the advantage of it to that book.

You mention your being in your 78th year—I am in my 79th. We are growing old together. It is now more than 60 years since I left Boston: but I remember, well, both your father and grandfather, having heard them both in the pulpit, and seen them in their houses. The last time I saw your father was in the beginning of 1724, when I visited him, after my first trip to Pennsylvania. He received me in his library; and on my taking leave, shewed me a shorter way out of the house, through a narrow passage, which was crossed by a beam over head. We were still talking as I withdrew, he accompanying me behind; and I turning partly towards him, when he said, hastily, 'stoop, stoop!' I did not understand him, till I felt my head hit against the beam. He was a man who never missed any occasion of giving instruction, and upon this he said to me: "You are young, and have the world before you: stoop as you go through it, and you will miss many hard thumps." This advice, thus beat into my heart, has frequently been of use to me; and I often think of it, when I see pride mortified, and misfortunes brought

upon people by their carrying their heads too high.

I long much to see again my native place; and once hope to lay my bones there. I left it in 1723. I visited it in 1733, 1743, 1753, and 1763. In 1773 I was in England. In 1775, I had a sight of it; but could not enter, it being in possession of the enemy. I did hope to have been there in 1783; but could not obtain my dismission from this employment here: and now, I fear, I shall never have that happiness. My best wishes, however, attend my dear country, "*esto perpetua.*" It is now blest with an excellent constitution; may it last forever!

This powerful monarchy continues its friendship for the United States. It is a friendship of the utmost importance to our security; and should be carefully cultivated. Britain has not yet well digested the loss of its dominion over us; and has still, at times, some flattering hopes of recovering it. Accidents may increase those hopes; and encourage dangerous attempts. A breach between us and France would infallibly bring the English again upon our backs; and yet we have some wild heads among our countrymen, who are endeavoring to weaken that connexion.

Let us preserve our reputation by performing our engagements; our credit, by fulfilling our contracts; and our friends, by gratitude and kindness: for we know not how soon we may again have occasion for all of them. With great and sincere esteem, I have the honor to be, Reverend Sir, your most obedient and most humble servant, B. Franklin.

Passy, May 12, 1784.

[From the Journal of the Franklin Institute.]

Abstract of the Specification of a Patent for a Machine for Moulding Bricks. Granted to William C. Grimes, of York, in the county of York, in the State of Pennsylvania, December 2d, 1834.

This machine is constructed upon the following general principles. A wheel is affixed horizontally to, and revolves with, an upright shaft, the latter being properly supported above and below by a suitable step and box, in which its gudgeons turn. The moulds in which the bricks are to be formed are placed around and upon the face, or upper side, of the wheel, near its periphery; these may stand in the direction of radii from the centre of the wheel, or otherwise. Two or more moulds may be united or connected together. A hopper, or trough, of sufficient capacity, is placed in an inclined position, with its lower end over one or more of the moulds at a time, as they pass under it. This hopper is to contain the tempered clay of which the bricks are to be made, and though that part of the bottom of it which projects over the mould, or moulds, an opening, or openings, are made of the length and width of a brick, through which the clay is to descend into the moulds. The motion of the wheels is not to be continuous, but intermitting; while it is at rest, a mould is immediately beneath the opening in the bottom of the hopper, or trough, and the clay is then forced by a piston down into it; the piston then rises, and the wheel moves, and the moulds are thus filled in succession. As the filled moulds pass round upon the wheel, they are removed, and replaced by empty ones.

It is manifest that two or more moulds may be filled at the same time, by the use of two or more openings and pistons, and the employment of such other devices as may thereby be rendered necessary, sufficient power being applied for that purpose.

The number of moulds will depend upon the diameter of the wheel, which will admit of considerable variation, but from four to six feet I think the most convenient.

The moulds must be slightly attached to the face of the wheel, which may be done in various ways, the following being among the best. From the under side of the moulds project two dowel pins, which fit into corresponding holes in the face of the wheel, by which means the moulds are kept from any lateral or horizontal movement. The dowel pins should be short, so that the moulds may be readily disengaged from the wheel. The holes for the pins, or dowels, in the face of the wheel, should be pierced through it, so as to prevent them from being filled, or choked with dirt, &c.

Two or more moulds may be united in one frame, as is usual in brick moulds. The frames of the moulds are inclined from each other, like key-stones, so as to stand as radii from the centre of the wheel, thus forming the proper arch or curvature around the wheel, and their upper surfaces should form a true plane. Each frame of moulds has a thin plate,

or board, which is equal in length and breadth to its corresponding frame, and forms the bottom or bed of the moulds. The aforesaid dowel pins pass loosely through holes made for the purpose in this plate; the latter not being otherwise fastened to the moulds, its use will be apparent to any one acquainted with the usual mode of moulding bricks.

The machine may receive its motion by a strap, carried around the fly-wheel, and over a drum, or pulley, which last may be driven by any competent power; or the machine may receive its motion by a crank attached to the fly-wheel shaft, or in any other convenient mode.

I do not mean to confine myself to the particular form or arrangement of the parts as before specified, but to vary them as experience or convenience may dictate, whilst the general principle remains unchanged.

What I claim as new, and as my invention, and for which I ask letters patent, is, 1st. The moulding of brick upon, or in moulds upon, the face of a revolving horizontal wheel, disk, or rim, constructed and acting upon the principle herein specified.

2d. The manner of forcing the clay into the moulds, by the combined action of a feeder and piston.

3d. The general construction and combination of the respective parts of the above described machine, from which general combination it derives that character by which it will be readily distinguished, by any competent machinist, from the various machines for moulding bricks already in use.

And I do hereby declare that I do not intend to claim as my invention, the piston, cranks, hopper, or any other part of the said machine, taken separately and individually, as these may constitute the elements of other machines; but, as aforesaid, the construction and combination of these parts upon the principle by me devised, and herein fully exemplified.

WILLIAM C. GRIMES.

The foregoing comprises about one-half of the specification, the remainder generally referring to the drawings. The same remark will apply to the next patent, and also to those for making nails. The machines manifest much ingenuity, and an account of their performance, when completed, has been promised, which, if satisfactory, will appear in the Journal.—[ED. J. F. I.]

Abstract of the Specification of a Patent for a Machine for Pressing Bricks. Granted to WILLIAM C. GRIMES, of York, York county, Pennsylvania, December 2d, 1834.

The general principle of the construction and operation of this machine is briefly as follows.

Upon a vertical shaft, or spindle, is fixed a wheel, disk, or rim, of sufficient size, which is to revolve horizontally. In the upper face of this wheel are a number of holes, or mortises, which are the moulds in which the bricks are to be pressed. The bottoms of these moulds are not a fixed portion of the moulding wheel, but are the upper faces of movable pistons, that slide up and down in the moulds, as the wheel revolves. The rods, or posts, which support and guide the pistons, descending vertically from them. The lower ends of the piston rods, or posts, slide round as the wheel revolves, upon a circular horizontal platform, or rim, or rather upon two platforms, one-half of the circle, or thereabouts, being elevated above the other about two or three inches. When the pistons rest upon this elevated portion of the circular rim, or platform, their upper faces are flush with, or above, the upper surface of the wheel; hence the bricks which have been pressed, being thus raised, can be removed with facility; while upon the opposite side of the wheel, the pistons upon the lower portions of the rim have their upper surfaces sunk down within the moulds, leaving cavities into which the bricks are dropped, as the pistons are depressed, the motion of the wheel, which is intermitting, not being too rapid for that purpose.

Just before the pistons rise on to the elevated portion of the circular rim, they pass under the short end of a strong iron lever, which projects over the face of the horizontal moulding wheel, far enough to cover the moulds as they pass under it. The level receives a continuous motion from a crank and shackle bar, the latter being jointed to the opposite, or long end, of the lever. The crank is regulated and assisted by a heavy fly-wheel, in

passing that point in which there is the greatest resistance to its motion.

While a brick is being pressed by the short end of the lever, the moulding wheel is at rest, as it receives its motion by a pall, or movable hand, that has a vibratory or reciprocating motion, which it receives from a crank fixed for that purpose on to the end of the fly-wheel shaft.

The horizontal moulding wheel may be of iron, and cast in one entire piece, of such thickness as may be necessary to its strength, the requisite depth of the moulds being formed by a flanch, rim, or projection, standing out upon the face of the wheel, the said rim, or flanch, making the sides and ends of the moulds. The moulds being in a circle, are placed as near to the periphery of the wheel as a proper thickness of metal will allow; the inner ends of the moulds may approach very near to each other, leaving only sufficient strength of metal between them; hence it may be seen that the number of moulds in the face of the wheel will depend entirely upon its diameter, which may be very much varied, but from three to six feet I think the most suitable.

The moulding wheel, pistons, horizontal rim, and fly-wheel, should consist of cast iron, and, in fact, the whole machine should be made of metal.

Motion may be given to the machine by a strap, carried round the fly-wheel, or by the crank attached to the end of the fly-wheel shaft, which may project beyond its bearing for that purpose.

I do not mean to confine myself to the particular form and arrangement of the parts as before specified, but to vary them as experience or convenience may dictate, whilst the general principle remains unchanged.

What I claim as new, and as my invention, in the above described machine for pressing brick, and for which I ask letters patent, is—

1st. The revolving horizontal wheel of moulds, constructed in the manner, or upon the principle, herein described, in which the processes of putting in, pressing, and removing the bricks from the moulds, are all done at one and the same time.

2d. I also claim the revolving pistons, as connected with the revolving moulds, and operating in the manner, or upon the principle, set forth in the foregoing specification.

3d. I also claim the employment of the stationary rim with a double platform, for raising and depressing the pistons, as before described.

4th. I also claim the scolloped rim, or flanch, for the purposes hereinbefore set forth.

5th. I also claim the pressing of brick by means of a lever, operating, and operated upon, as herein shown.

6th. I also claim the general construction and combination of the respective parts of the above described machine, from which general combination it derives that character by which any competent machinist will readily distinguish it from any of the brick pressing machines previously in use. But I do not claim the pistons, fly-wheel, shafts, or any other part, taken individually, as these may constitute the elements of other machines; but, as aforesaid, the construction and combination of these parts upon the principle by me devised, and herein fully exemplified. WILLIAM C. GRIMES.

On Various Modes of Imitating Bronze, translated from the Dictionnaire de l'Industrie Manufacturière Commerciale et Agricole; Article, Bronzage. By M. H. GAULTIER DE CLAUBRY. [Translated for the Journal of the Franklin Institute by Wm. W. Smith, at the request of the Committee on Publications.]

A bronze color, varying according to the nature of the substances used to produce it, and approaching more or less to the natural tint, is given to many articles of plaster, wood, paper, or pasteboard. A very brilliant bronze is produced by gold leaf rubbed on a muller, with honey or gum; goldbeater's clippings are used for this purpose. *Aurum musivum* may be employed for the same purpose; one part of this, and six of calcined bones, must be finely pulverized; a small quantity is taken on a moistened rag, rubbed over the article to be bronzed, which is then scoured with a dry piece of linen, and submitted to the burnisher.

When aurum musivum is to be fixed on paper, it is powdered without the calcined bones, and mixed with the white of eggs, or a light varnish of alcohol; this mix-

ture is applied with the brush, and the article is afterwards burnished.

When a plate of iron is immersed in a diluted and boiling solution of sulphate of copper, the copper is precipitated in the state of a powder, which can be easily washed by agitating it with water. This powder, mixed with six times its weight of calcined bones, also in fine powder, may be substituted for the preceding mixtures.

It is sometimes desirable to give articles a grey color, nearly resembling that of iron; this is called white bronze; it is produced by several methods. Argentum musivum gives a very pretty tint; tin reduced to an extremely fine powder, (by pouring it, while fused, into a box, the interior of which is well covered with pulverized chalk, and shaking until perfectly cold,) is also used. This powder, sifted and mixed with a solution of glue, is applied to the article, which takes a dull color; if brilliancy is required, the burnisher must be employed.

Argentum musivum is an amalgam of equal parts of bismuth, tin, and mercury.

When plaster is to receive the white bronze, it is rubbed with plumbago.

Well cleansed cast iron, dipped into a weak solution of sulphate of copper, becomes coated with copper, which adheres to its surface; under these circumstances the copper assumes a reddish hue, which passes to yellowish brown.

Bronze, exposed for some time to the action of the atmosphere, is covered with a very thin coating of carbonate, which gives it a green hue, known by the name of "patine antique." Imitations of this tint have been attempted in various ways; but however great may be the resemblance of these artificial colors to those produced by time, there are still certain characteristic shades, which a practised eye can easily detect; the antiquary should not, therefore, complain, since it is always possible for him to distinguish an "antique" from an imitation.

The hue of antique bronze is given to bronzed articles intended for house ornaments, or to medals, by treating their surfaces with different compounds. A great number of these mixtures have been recommended; many of them answer sufficiently well, but the beauty of the product depends very much on the manner of applying them, for different workmen, using the same composition, obtain very different tints.

We will here merely enumerate some mixtures with which our best workmen produce handsome colors. The metal having been well scoured with nitric acid, the compound is very uniformly spread over its surface with a proper linen roll, or brush.

The bronze color obtained, whatever may have been the mixture employed to produce it, will depend on the nature of the alloy: since the alloys used for casting the ornamental articles which are to be bronzed vary, it follows, of course, that the same bronzing mixture, applied in the same manner, cannot in all cases produce the same tint.

Nitric acid diluted with two or three parts of water is rubbed over the metal; the color is at first greyish, but soon becomes greenish blue.

A solution of one part sal ammoniac, three carbonate of potash, six of common salt, and eight nitrate of copper, in twelve parts of boiling water, is rubbed at intervals on the metallic surface; the tint is unequal and harsh, but it softens, and becomes more uniform.

A beautiful greenish blue bronze may be obtained by washing a copper surface with concentrated aqua ammoniæ, for a sufficient length of time.

The base of nearly all the compounds employed is vinegar and sal ammoniac. Thus, skilful workmen use nothing but a mixture of sixty grammes* of sal ammoniac, and a litre† of vinegar.

Another mixture, which gives good results, is composed of thirty grammes of sal ammoniac, eight grammes of salt of sorrel, and ten litres of vinegar.

An experienced chaser of Paris uses a mixture of 15 grammes of sal ammoniac, 15 grammes common salt, 30 grammes spirit of hartshorn, and 1 litre vinegar.

One litre of vinegar, 15 grammes of sal ammoniac, 15 grammes of common salt, and 15 of ammonia, form a good mixture. A soft brush is dipped in the mixture, and the article is rubbed with it until it takes a handsome bronze tint; the piece should be barely moistened, and

* A gramme is equal to 15.4 grains.

† A litre equals 1.76 imperial pint.

any excess of liquid should be removed by another brush. If, after two or three days, the tint is found to be too pale, the process is repeated. The work may go on in the air, the color takes better; the copper need not be heated.

The two following compounds produce a handsome effect:

Eight grammes of sal ammoniac, 8 grammes of common salt, 16 grammes of ammonia, one half litre of vinegar.

Two grammes of salt of sorrel, eight grammes of sal ammoniac, one fourth litre of vinegar.

The mixture is applied with a brush which is almost dry, and the operation is continued until the desired tint is obtained. These compounds produce a better color when the process is conducted in the sun.

Medals are colored in a different manner; they are immersed in a liquid the composition of which varies much.

Five hundred grammes of powdered sub-acetate of copper are thoroughly mixed with 333 grammes of sal ammoniac, also in powder; make a paste of this, with one part of a glass of vinegar. Take a piece of paste of the size of a walnut, mix it with the remainder of the vinegar, and a litre of water; boil it for a quarter of an hour; allow the solution to repose, and decant the clear liquid. To bronze medals, pour some of this boiling liquid over them, continue the ebullition for five or six minutes, decant the solution, and wash the medals perfectly clean. The same liquid cannot be used more than five or six times; at each time, a quarter of a glass of vinegar must be added. The process must be carried on in a copper pan; the medals are to be fixed on small blocks of wood, so that they cannot come into contact with the pan, or with each other.

The medals should be well wiped immediately, that the tint may not change; then dried with care, and subjected to the burnisher, to render them bright.

It almost always happens that some of the pieces take a bad tint; very often some are spotted.

A mixture of 510 verdigris, 250 sal ammoniac, rubbed with vinegar on a marble slab, and transferred to well closed vessels, is used in the same way; a piece is added to a glass of vinegar, and two litres of water, and the whole boiled for ten or twelve minutes.

A good bronzing mixture for alloys of lead and tin, consists of 100 parts of nitrate of copper, perfectly pure and neutral, in a solution at 18° of Baume's hydrometer, and 20 parts of sal ammoniac; this liquid must be applied so as to wet the metal as little as possible.

We will here detail the Chinese process of bronzing, as it is a curious one:

The copper is washed with vinegar and ashes, until it becomes perfectly bright; it is dried in the sun: 2 parts verdigris, 2 cinnabar, 5 sal ammoniac, 2 duck's bills and livers, and 5 alum, are to be finely pulverized and well mixed; a liquid paste is made with this mixture; the copper is covered with the paste; it is then heated, allowed to cool, and the paste removed; this is repeated eight or ten times. The copper assumes a pretty tint, which is so durable that the action of the air and rain does not impair its beauty. A mixture of 1 part of sal ammoniac, 3 cream of tartar, 3 common salt, 12 hot water, and 8 of a solution of nitrate of copper, gives a good bronze. By increasing the quantity of common salt, the color becomes clearer, and approaches to yellow; by diminishing the proportion of the same, or omitting it altogether, different shades of blue may be produced. The action is increased by adding a greater proportion of sal ammoniac.

Certain articles are bronzed red by coating them with oxide of iron, and exposing the pieces to heat; the same tint may be given by rubbing them with a liquid containing one-thirtieth of sulphuret of potassium; the color readily changes to greenish brown.

Gun barrels are bronzed by being rubbed with fused chloride of antimony; this must be repeated several times. To obtain a successful result, the barrels must be gently heated.

MM. d'Arcet and Thenard proposed a cupreous soap, with which, when plaster is impregnated, it assumes so much the tint of ancient bronze as to deceive the eye, and its real character can only be ascertained by touching it.

Pure linseed oil is converted into a neutral soap by caustic soda; to this a strong solution of common salt is added; and

the whole is boiled until the liquid has a great specific gravity, and the soap swims at the surface in small grains; the solid matter is to be drained and pressed, to rid it as much as possible of the fluid; dissolve this soap in distilled water, and pass the solution through linen; dissolve also in distilled water, 80 parts of sulphate of copper, and 20 parts of sulphate of iron; filter, and into the latter solution pour the solution of soap, until decomposition is complete. A little sulphate is now added, and the whole stirred several times at intervals, and then boiled; in this way the soap is mixed with an excess of sulphate. It is washed first with a large quantity of boiling water, next with cold water, and thrown on a linen, pressed and dried as much as possible.

Boil a kilogramme (2.2 avoird. lbs.) of pure linseed oil with 250 grammes of pure finely powdered litharge; strain through a linen, and allow the oil to stand in a stove; it clarifies much better there.

Fuse together in a delft-ware vessel, on a steam or water bath, 300 grammes of boiled linseed oil, 160 soap of copper and iron, 100 pure white wax, and keep the mixture melted some time, to deprive it of moisture. Heat the plaster in a stove to 80° or 90° Centigrade, and apply the fused preparation; when the plaster has become so cold that the mixture will no longer penetrate it, it is again placed in the stove and heated to 80° or 90° Cent.; more of the mixture is applied, and this operation is repeated until the plaster has absorbed enough; it is then again placed in the stove to deprive its surface of color; the porosity of the plaster is such that the mixture penetrates it without leaving the finest lines soft, and this result is obtained by no other method; the depth to which the preparation sinks is greater or less, according as the piece has been placed a greater or less number of times into the stove.

When the article has absorbed a sufficient quantity of the soap, and has taken the required tint, its surface is gently rubbed with a bunch of cotton, to give it the necessary brilliancy, and if it is desired to imitate natural bronze exactly, a small quantity of shell gold is applied to the raised parts. It sometimes happens, that flaws and other defects render it necessary to insert a piece in statues; the tint of these pieces never exactly resembles that of the surrounding bronze; this effect is perfectly imitated by cutting out a piece of plaster, and running some other plaster into the cavity; the tint of the replaced part differs from that of the mass, and resembles exactly the defect in real bronze.

This process affords the means of obtaining articles of plaster, resembling very closely those of real bronze; medals, busts, and even statues, may be finished in this way, provided a stove of suitable dimensions can be procured; the process presents some difficulties, and to these many have yielded; we will mention them for the sake of those about to engage in this art, to show them the faults of others, and furnish them with the means of surpassing their predecessors. It should first be stated, that, with proper care, this process affords most satisfactory results. M. d'Arcet himself prepared some articles which were taken for bronzes of superior beauty by skilful artists; the same success may attend operations on a larger scale.

When the plaster is moistened unequally, it does not absorb the soap uniformly, because the porosity of the parts is not equal; the consequence is, that the surface takes various tints; when the pieces are small, this defect need not be feared; but when they are busts, or castings of large size, it frequently happens that contiguous parts take very different shades of color, and spots will sometimes be perceived, very slightly, if at all, altered by the process.

The occurrence of these blemishes may be avoided by carefully casting the pieces to be bronzed, expressly for this purpose, and ascertaining by a few trials what quantity of water must be used, in order that the cast may assume the finest shade; with these precautions the process may be conducted successfully, even on a large scale.

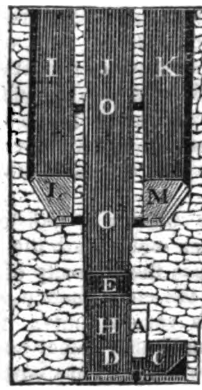
The small pieces are dipped into the melted compound, then shaken, and dried on one side to cause the absorption of the composition remaining on the opposite surface; this may also be accomplished by exposing the surface to a bright fire. A gilder's chafing dish must be used for large articles.

A variety of articles, such as time-pie-

ces, vases, &c. may in this way be manufactured, which resemble very much handsome ornamental bronzes, and can be sold at low prices; it is only surprising that this art is not cultivated to a greater extent, as these ornaments might, by a little perseverance, be introduced into general use. Plaster finished in this manner may be exposed to air, moisture, or even rain, without being injured.

[From the Journal of the Franklin Institute.]

Abstract of a Specification of a Patent for a Furnace for Preparing and Smelting Iron Ore, with Anthracite Coal. Granted to Thomas S. Ridgway, Pottsville, Schuylkill county, Pennsylvania, December 17, 1834.



The hearth of the smelting furnace, or stack, as seen in the section, letter J, may be in the usual form of smelting furnaces, and receive the blast at one or more openings in the bellows wall, made for the purpose, excepting the wind wall, opposite the blast, marked letter H, which is at an angle of forty-five degrees, or thereabout, and extending up the said wall of the stack to the bottom of a door or opening, letter E, made for the purpose of rendering the fire manageable; this door will be placed in the stack at the top of the smelting fire, which will be from four to six feet high above the hearth, that being about the maximum height that a blast can be forced through anthracite coal; whereas the usual height to which it is forced in a charcoal furnace is thirty-five feet.

Another stack, marked I, in the section, to be charged or loaded with anthracite coal, and kept hot by caloric received from the smelting stack by means of one or more openings in the wall of the smelting stack, opposite O, marked in the draft, at a convenient height above the smelting fire, or by means of a separate fire, as the case may be; the intention of this operation is to dissipate sulphur from the coal, and keep it in a proper state of heat for the smelting fire, without useless consumption of fuel. At the bottom of this stack is a door for the purpose of taking out the coal, after it is prepared to put on the smelting fire.

The purifying and carbonating stack, oven, or chest, marked K in the draft, may be attached to the smelting furnace, or be apart from it, and receive caloric or heat from the smelting furnace, by one or more apertures in the wall of the smelting stack, opposite the letter O in the draft, or by a separate fire. This stack is to be loaded or charged with iron ore and anthracite coal, or charcoal, for iron ore and charcoal, together with the proper fluxing materials, as may best prepare the ore before it is put on the smelting fire. There is a door in the bottom of this stack, for the purpose of taking out the ore after purification. This indispensable operation of carbonating the ore cannot be performed without heat, in the absence of oxygen, nor can it be performed in the usual way, owing to the great specific gravity and slow combustion of anthracite coal; whereas, in this way, only a very small quantity of charcoal will be required to purify and carbonate a ton of ore.

What I claim as my own invention, is the carbonating stack, oven, or chest, and also the stack for preparing the anthracite coal, and relieving the smelting fire of the great burthen of ore and anthracite coal requisite in the usual way of smelting; also the inclined wind wall, which renders the smelting fire so manageable that it may be stirred as often as required; and, lastly, the combination of the above three stacks. These may be built of stone, or any good, durable material, and of any convenient size or capacity, suitable to the power of the blast, with valves at the tunnel heads, or top, to regulate and direct the heat from one stack to another.

Thomas S. Ridgway.

[From the Farmers' Register.]

On Price—the Causes and Effects of the Fluctuations considered, and the Principles maintained applied to the Present Rage for Speculation. By Thomas R. Dew, Professor of Political Economy, &c., in the College of William and Mary.

[The following communication was intended by its author to appear anonymously—and it may be observed that its form still accords with that intention — though we have obtained permission to give the author's name. This mark of its origin was desirable, not only for reasons which are sufficiently obvious, but also because the facts treated of are in some degree effects of the causes considered by the same writer in his "Essay on Usury," in Vol. II. of Farmers' Register — and the reasoning of the two communications have a corresponding connexion.

The exhibition of the principles which constitute *price* in general, and the investigation of the causes of unfounded and ruinous fluctuations, may be serviceable to the agricultural community at this time, when there is every indication of the approach of one of those fits of national delusion or madness, such as occurred in the time of non-specie paying banks in this country, and such as every commercial country is sometimes liable to suffer from.

In addition to the close connexion of this and many other subjects of political economy with agricultural interests, we find ground for especial approbation of Professor Dew's manner of inculcating his doctrines, by showing their bearing on current events, and offering tests of their truth, in accessible and striking practical proofs. Without resort to some such mode of attracting attention to what is generally (though incorrectly) deemed a dry and repulsive study, the abstract truths of political economy will continue unknown to governments and to nations, long after having been established and undoubted in the opinions of reading men. Thus Adam Smith's exposure of the restrictive (or commercial) system of Europe had delighted and convinced the learned and literary community for half a century before it had any effect on the action of the British government, and his admirable work had long been a text book in the colleges in the United States, while our legislators still continued to act in defiance of its truths, on questions of national policy, and in accordance with the notions on trade of the past ages of darkness and ignorance.

Having thus expressed general approbation of the author's views, it is proper to mention an exception — which expression of dissent would otherwise be uncalled for, and unnecessary. It relates to the effects anticipated to Virginia from the present high price of slaves. That such consequences, whether immediate or remote, will follow, we have not been convinced by the author's argument.—Ed. Farm. Reg.]

But a little while since, as we all but too well remember, the country was plunged into the utmost distress from want of money, lowness of prices, and failure of credit every where; now we seem to be fast rushing into the opposite extreme—money is becoming very plentiful, prices have almost doubled, and commercial credit seems every where re-established. A speculating mania has been generated in our large commercial cities, and seems rapidly spreading itself through our country. If then this be a season of prosperity, it is one of hazard likewise. Now is the time for the exertion of that prudent foresight and calm deliberation, which alone can carry the man of wealth safely through those great and sometimes rapid fluctuations of prices, always attendant on the rage for speculation. I propose briefly in this communication to point out the operation of those causes which are calculated to make money plentiful or scarce, (as it is commonly termed,) and to show their operation on prices at this moment. This investigation cannot, I think, fail to be interesting at this time, and I hope will call forth the speculations of others much more competent to do justice to the subject than myself.

Circulating Medium.—The first subject, undoubtedly, to which we must turn our attention in an investigation of this kind, is to the currency. What is the currency? What are the items which compose it? Every thing which passes from hand to hand, and will perform the function of money, must be regarded as currency. First then come the gold and silver coins, and bank paper; these of course form a part of the circulating medium, but not the only, or even the greatest or most important portion. Bonds, promissory notes, scrip notes, bills of exchange, stocks of every description, form likewise a portion of the circulating medium. All of these pass from hand to hand, and represent value, and therefore perform the functions of money. For example, I buy a tract of land, for which I give $10,000, and pay for it by passing to the seller ten bonds of a thousand dollars each. Now this exchange is effected without a single dollar of real money, merely by the agency of credit: in the same way I might have paid for it in stocks, or by giving bills of exchange, &c. But although these are to be looked on as circulating medium, it is evident that equal

quantities of them will not perform as many exchanges as money; for the value of money is well ascertained—it bears no interest whilst in our hands, and therefore it circulates rapidly and effects many exchanges: whereas the value of bonds, promissory notes, bills of exchange, stocks, &c., have a value more indefinite; and most of this species of paper, too, bears an interest while in our hands. Its circulation is therefore comparatively sluggish, in consequence, first, of the difficulty of fixing its value; and second, because we make a profit on it whilst lying in our hands, and therefore are in no hurry, generally, to get rid of it. But although this portion of the circulating medium be greatly inferior to money in the performance of the functions of circulation, yet it much more than makes up for this deficiency, by the vast amount of it which is in circulation. In England, for example, it has been computed that the bills of exchange alone in circulation are ten times more in amount than the whole money in the country: while the latter is estimated at £40,000,000, the former reaches the enormous aggregate of £400,000,000. In our country, the Bank of the United States alone does a business in exchange amounting in the year to more than $250,-000,000; while its own paper in circulation has never reached one capital, or $35,000,-000. Now, the bonds or promissory notes of individuals may be looked on as rising, in amount, infinitely beyond the aggregate of the bills of exchange and money together. Comparing then all the items of the circulating medium, *exclusive* of money, with the money, we shall be astonished to see how insignificant in quantity the latter is, when compared with the former. The fact is, money performs but few of the exchanges of society, by actual passage from hand to hand. "In England," says Mr. Wade, "by the use of bills of exchange, bills of lading, checks, scrip notes, clearing houses, and a variety of other contrivances, aided by a vast fabric of credit taken and given in open account, money (in its common acceptation) hardly ever enters into mercantile affairs; it is the substance really meant and shadowed forth; but it rarely, as one may say, bodily passes from hand to hand." In our own country, every one, too, must have observed how rarely the exchange of large masses of property are effected by the intervention of money. In the great majority of cases, the property is paid for by the passage of bonds, bills of exchange, stocks, &c. and but a small portion by actual money. Hence what are called cash sales, if too frequent all of a sudden, in a particular neighborhood, even in times of great prosperity, will cause the property to be sold at a sacrifice, because of the great difficulty of commanding the actual money to make the purchase.

Effect of Rapidity of Circulation.—Having thus explained my notion of the components of the circulating medium, and shown that money is vastly inferior in amount to all the other items combined, let us now look a moment to the effect produced on the circulating medium by a rapid or sluggish circulation. And it is very evident, that while the quantity of the currency remains the same, its apparent amount and real efficacy may be either increased or diminished, merely by an increase or diminution of the rapidity of circulation. For example, $10 passing through ten hands, in the course of the day, will accumulate as much property as $100 passing only once from hand to hand. Now, supposing the whole circulating medium to remain stationary in amount, but that the rapidity of its circulation is suddenly doubled throughout the whole country, then its *apparent* amount and its *real* efficacy would be doubled likewise. With the help of these incontrovertible principles, let us now proceed to examine into the effect of the late money pressure in the United States: 1st, On the rapidity of the circulation—and 2dly, On the amount of the circulating medium.

1st. *Effect on Circulation.*—I shall not pretend to enter into an investigation of the causes which produced the late pressure in the money market. The nation has already been fully and completely enlightened upon this subject, by men whose minds can compare with any which the world can furnish. Moreover, it would require me to enter more fully into the field of politics than would be agreeable to myself, or suitable to an agricultural journal. Suffice it to say that the pressure did every where take place; that a general difficulty of procuring money existed throughout the country; that prices, for a season, fell every where; and that confidence and credit for a short time, in the great commercial towns, were almost entirely destroyed. First let us see the effects of all this on the exchanges in society, and then on the rapidity of circulation in the currency.

During a pressure of the kind just spoken of, the loss of confidence and fall of prices force a great deal of real and other property in the market, to be sold for payment of debts, which ordinarily remains stationary in the hands of its owners. Lands, houses, negroes, stocks of goods, &c., are thus forced to change hands, and of course increase the exchanges. Perhaps the sinking of prices generally may have a tendency to diminish the sales of the annual pro-

ducts of the soil, such as corn, wheat, tobacco, and sugar; but not of cotton, for the foreign market is the regulator of the price of this very important article. Hence it may be said, that a money pressure at first has a tendency, by the great quantity of property forced into the market for sale, rather to increase, than diminish the number of exchanges. Whilst, however, the number of exchanges increase, the circulating medium suddenly becomes much more sluggish, taking the whole aggregate, in performing the functions of circulation. The great capitalists, who are in the habit of purchasing produce with a view to sell with a profit, when prices are falling, rather keep aloof from the purchase of raw produce, least a further fall may injure them—their capital then circulates more slowly, and in consequence of it, the annual productions of the country are not distributed with that regularity, and adaptation to the various wants of the community, as under ordinary circumstances. The body politic, in this situation, is like a patient suffering congestion in one part of the system, while there is a depletion almost to the loss of vitality in another.

Again: bonds, bills of exchange, &c., ordinarily performing the larger portion of the circulation of every country, have now a much slower circulation, and consequently less efficacy in effecting the exchanges; because as there is a general loss of confidence and credit, A, who has sold to B, is distrustful of his bonds, his bills, in fine of credit in every shape — he wants money. Money too has generally a sluggish circulation on such occasions, for every one getting possession of it, is disposed to hold it as long as possible—hard money seems to be almost the only true friend which one can get hold of in such times as those, and is consequently held with a miserly grasp. Persons will not venture it out without the best security, and on high rate of interest, obtained either directly or indirectly.*

Thus we find, first, that the number of exchanges has a tendency to increase during the first operation of a money pressure; and second, that the whole circulating medium of the country suddenly, from the very same cause, diminishes in the rapidity of its circulation, and therefore becomes less efficacious, as I have already proved.

2d. *Effect of money pressure on actual amount of circulating medium.*—Let us now examine into the state of the circulating medium, and see whether, during a money pressure, it has any tendency to increase in quantity, so as to counteract the operation of the causes above specified. It is evident, first, that the money has no tendency to increase in quantity; because, first, the banks are distrustful of the credit of individuals, and of one another; the curtailment forced on one communicates to another, and finally all are obliged to curtail their accommodations and issues—hence a decided diminution in bank paper. Secondly, gold and silver in actual circulation diminishes in amount, because of the universal disposition to hoard, in consequence of loss of confidence. Thirdly, bonds and bills of exchange will generally diminish in amount, because these depend on credit altogether, and the first effect of the pressure is the destruction of confidence, and the ruin of the whole fabric of credit. Fourthly, stocks of every description diminish in value, or are entirely destroyed, by the disastrous operation of the times. Money, and not stocks, is what the times call for. And thus do we see, that while the exchanges increase, the circulation of the currency grows sluggish, and the quantity in actual circulation rapidly diminishes.

Combined effect of these causes.—What then, let me ask, is the effect of the combined operation of an increase in the number of exchanges, greater sluggishness in the circulation, and diminution of the whole circulating medium? Most undoubtedly, a continued fall in prices, until certain causes are thrown into operation, which will counteract this downward motion. Mr. Hume, in his History of England, says there is a point in the depression of nations, in the scale of circulation, below which they cannot sink. Amelioration will then spring out of the very disorder itself. So I would say in the disasters of trade and agriculture, there is a certain point of depression below which they cannot go. The self-sustaining energies of commerce are called into play, and apply the healing balm without the interference of government. Thus the causes, whose operation I have just been considering, gave a downward motion to prices in our country, until they reached that point which made this one of the worst markets in the world to sell in, and one of the best to sell from. The effect of this on foreign exchange will readily be perceived. More commodities were exported than imported. A money balance was created in favor of the nation. Hence a rapid and full current of the metals was soon seen flowing steadily into the country, and supplying the vast deficit in the circulating medium, occasioned

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* An inconvertible bank paper is never hoarded in this manner. It is like fire in each man's hands, he wants to get rid of it as speedily as possible, lest it may be caught on him at a still lower point of depreciation. Hence the inconvertible paper of the Bank of England, in 1797, soon relieved the money pressure, but only to bring on evils greater still, as an inconvertible paper always will do.

by sluggishness of circulation, and diminution of the quantity, from general destruction of confidence and credit. We all very well recollect that, a short time since, almost every paper announced the fresh arrivals of cargoes of gold and silver—and we know that, at this moment, we have more foreign coins in circulation than have been seen in the country for years past. The banks too seem generally to have drawn to their vaults large portions of the precious metals.

Effect of importation of precious metals, and of a restoration of confidence.—Now, whilst the importation of the metals from abroad is gradually adding to the circulating medium, and therefore partially relieving, by this means, the pecuniary distresses of the country, the number of exchanges in society occasioned by forced sales will of course have a tendency to diminish, because those sales will become less and less frequent, after the violence of the storm has already prostrated all that could not stand against it. Affairs will soon settle down to this new state of things. Many of the wealthy men of the former epoch find themselves bankrupts at the commencement of the new—others again, who could command a little ready cash during the crisis, find they have suddenly become wealthy. From this point, the operations of commerce once more begin to extend themselves. Confidence is gradually restored, and with it the credit system begins to be built up again, and the large accession of money from abroad makes the money market much easier than before. The effect of all this is at first to raise prices gradually, and then more rapidly, as a spirit of speculation is generated. When prices are sinking, the spirit of speculation sinks likewise, because each individual is fearful of purchasing, lest he be injured by a farther fall in prices. The credit system likewise is greatly contracted, because the rapid fall in prices, and the frequent bankruptcies occurring from day to day, destroy the confidence of man in man.

Now a rise in prices is accompanied with effects the reverse of these. 1st, The credit system becomes instantly enlarged. When prices are rising all are on the alert: the energies of man are drawn forth; his hopes, which ever have an undue influence, are thrown into play, and the imagination spreads enchanting schemes and projects before him; he is disposed under those circumstances to rush into business, or to get possession of property, whose enhancement in value from the rising tide of general prosperity, is alone expected to make him wealthy. The borrower now can much more easily get money on loan than before, because general confidence is restored, and the constant rise in prices makes property a good security, which before would have been deemed very inadequate. Buying and selling too, under these circumstances, will generally be on credit more and more extended in proportion to the restoration of confidence. Now the immediate effect of the extension of credit, and the increased velocity given to the circulating medium, is to produce a superabundance of money. For, recollect, I have previously shown that sluggish circulation and the destruction of the credit system generated an extraordinary demand for money, which flowed into the country through the medium of importations. The increased velocity of circulation and the re-establishment of the credit system have just the opposite effect, viz. to increase the apparent amount and the real efficacy of the whole circulating medium. Now, when we reflect that the currency has received immense additions during the money pressure from abroad—that the portions hoarded by individuals are thrown into circulation as soon as the panic subsides—that the banks which have rode through the storm are beginning to increase their business and push out their paper, and thus add to the circulating medium—that the United States' Bank has recovered from the shock which it sustained by the removal of the deposites, and is consequently enabled to do a more liberal and extended business, thereby enabling other banks to enlarge likewise—we are not to wonder, under these circumstances, that we have a redundant circulating medium; especially, when we recollect that this increased currency is circulating with greatly increased velocity: and the effect of these combined causes must be a vast enhancement of prices, and a consequent rage for speculation. I will exemplify this by a very simple illustration. Let us suppose a particular neighborhood, whose exchanges, in ordinary times, are effected by $1000. Now I have shown, if any causes operate to make the circulation only one-half as rapid as the ordinary circulation, then the $1000 will not appear to our little district to be more in amount, or in real efficacy, than $500. In this state of things, throwing out of view all other causes, prices in the neighborhood supposed would fall to half their former amount. Now, let us farther suppose that this fall in prices should cause an importation of $500 additional into the neighborhood, and that the rapidity of circulation was again restored, do we not clearly see that we should have a currency redundant by $500? And this would not only, on the great principle of supply and demand, carry up prices to their former level, but would increase them, in the case supposed, fifty per cent. beyond

that level. Now what I have been saying here of a neighborhood, may with equal propriety be said of a whole nation. Let us suppose, for example, the circulating money of this country to be $100,000,000, in ordinary times; that the circulation becomes suddenly only one-half as rapid as before; then the whole $100,000,000, even supposing the quantity kept in circulation undiminished, will perform no more exchanges than $50,000,000 would with the former rate of velocity in the circulation. Prices then would generally sink to half their former amount; money would flow in, let us suppose $25,000,000; and immediately afterwards, the restoration of confidence, and the consequent re-establishment of the credit system, would communicate to the circulating medium the same velocity as before: you would then have a redundancy of twenty-five millions of dollars, and a consequent rise of prices at least twenty-five per cent. upon the principle of supply and demand alone. But the probability is, prices would rise greatly beyond this point, in consequence of the effect produced by a speculating mania—for when prices are rising, every one wants to purchase. Few are capable of reasoning upon the causes; hence an artificial competition is generated among the buyers, and property rises greatly beyond what it should do, upon the principal of actual supply and efficient demand. The reason of man on these occasions seems to be completely unhinged. He looks forward to the realization of wealth by changes in the price of property which he holds in his hands, and almost every one is disposed to turn speculator. And this speculating mania is generally first felt in regard to stocks, whose value is ever fluctuating, and therefore liable to the most sudden impulses, upwards and downwards. I understand at this moment the stock-jobbing spirit to the north has risen to a most extraordinary height. A gentleman, under date of the 28th April, writes me from Philadelphia, that railroads and canals are the order of the day there—that the papers scarcely find room for politics. He says, "two subscriptions have been opened for canals since I came here. The whole stock for the first was taken in thirty minutes. In the second, the whole stock was taken by the commissioners before the doors were opened. A rush and disappointment followed. Millions could have been taken," &c. All this arises from restored credit; from throwing suddenly the hoarded portions of money into circulation—from increased velocity of circulation—from issue of banks, &c.: all of which have contributed to make currency redundant, prices exorbitant, and the spirit of speculation wild and reckless. When I saw certain politicians congratulating the nation upon fresh arrivals of gold and silver a short time since, I could not but reflect upon the shallow knowledge of political economy which such congratulations proved. The influx of gold and silver was the clearest proof that could be furnished, of the general distress of the country; of the loss of confidence and credit; and of the stagnation of trade and the circulation. The importation of the precious metals could only be effected by parting with a large portion of our wealth; and as soon as a sound currency and circulation could be restored, this newly acquired portion was to be entirely redundant, and even mischievous in its operation, by raising in the community a speculating mania.

What is to check this rise in prices and spirit of speculation? — I will now examine into the manner in which this rise in prices is ultimately to be checked, and the spirit for speculation to be cured. And here let me observe, that as there is a certain point of depression below which prices will not go, in consequence of the *influx* of precious metals which this lowness of prices will certainly produce, so likewise there is a certain point in the elevation of prices beyond which they cannot well go, because of the *efflux* of the precious metals. It is this efflux which finally checks the speculating mania. I will explain: a rise in prices, when very great, makes our country a good market to sell *in*, but a very bad one to sell *from*; hence our imports will greatly overbalance our exports, and a money balance will be created *against* the nation, which must be paid in money. This produces the exportation of money until the redundancy is sent off; then prices fall, and ruin overtakes the most adventurous in the game of speculation—they involve others, and prices once more sink, from loss of confidence and credit, and stagnation in circulation, below their average level, to be brought up again by the operation of causes already pointed out. Whenever the pendulum of price, (if I may use the expression,) has, either by the operation of the natural course of events, or by the unwise and unskilful tampering of government, been thrown far into one extreme of the arc, it will, in its effort to regain its natural position, go almost so far into the opposite extreme; and the vibrations will frequently last through a long period of time.

Do these Fluctuations depend entirely upon the Banks?—Some suppose these fluctuations depend *entirely* upon the operation of the banking system. This, however, is not the fact. Banks may do a great deal, but are by no means omnipotent in the re-

gulation of a currency. For example; when loss of confidence, stagnation of circulation, and fall of prices, derange the whole credit system, banks are affected like individuals; they are obliged to curtail their operations and check the farther emission of paper, lest a run upon them may break them. They may not under these circumstances have the ability to relieve the distress, however strong the inclination; the relief must come through the wasting process of *buying* metals from abroad. Again, when prices begin to mount upwards, banks, by seizing upon the favorable moment, may enlarge their issues, and thus swell still farther the already bloated state of the currency. But they cannot prevent, if they be specie-paying banks, the correction of the evil exportation of the metals; for so soon as these are redundant, they will be gathered up for a foreign market; a necessary run will then take place on the banks for the purpose of making the collection, and these banks must either suspend specie payment, curtail their issues, or break. On the first supposition, the evil would have to correct itself by a rise in exchange against us with foreign countries, to the amount of the depreciation caused in the currency by suspension of specie payment. In the second case, prices would be lowered by contraction of the currency from curtailment. In the third, by contraction from the withdrawal of all paper which had emanated from the broken banks, and a loss of confidence in the whole banking system, which would, by the runs made upon them, force all to curtail or break. And thus may we always confidently look forward sooner or later, from causes whose operation I have pointed out, for either a rise in prices when they are very low, or fall when they rise very high. Whenever prices are disturbed, it is a long-time before the equilibrium is again restored.

Effect of Foreign Demand for some of our Agricultural Products on Present Prices.—So far I have been arguing as if the present state of things were the result solely of that re-action which must sooner or later take place after great depression and stagnation of trade. But the rise in prices may be rapidly accelerated by an extraordinary foreign demand for some of our great staples. Most undoubtedly the rise in the *price of cotton* has at this moment very great agency in the high prices and rage for speculation, manifesting themselves every where. The price of cotton in this country is regulated by the prices abroad, because the foreign market taking up about four-fifths of the whole product of the United States, it is evident that the value of the article must be determined by the foreign, and not by the home demand. What is the cause of the immense rise which has taken place in the price of cotton within a few months I am unable to say. I am not at this moment in a condition to get at the statistical information required for the investigation of this subject, and my mind not being particularly directed to it, until within a day or two past, I have not noticed from time to time in the papers such articles as might perhaps have given me a clue to the explanation of this interesting phenomenon. Whatever may be the cause, however, whether a general deficit in the cotton crops over the world, or in the United States particularly; or to the rapidly increasing demand for cotton fabrics all over the world; or to a spirit of speculation in England; or to the gradual reduction of the tariff; or to all these causes combined; certain it is, that the price of this most important agricultural staple is now at a height which well indemnifies the planter for his labor, and will, if it could continue, diffuse wealth and prosperity over the whole of our southern country.

Let us now examine into the influence exerted by this rapid rise in the price of cotton: and in the first place it is manifest, that the rise in the price of cotton must have had a most important influence on the foreign exchanges. This article alone constituting a very large portion of the whole of our exports, say two-thirds, a rise in its price has therefore tended to swell the value of our exports, and of course to make money flow more rapidly into the country, through the agency of a favorable balance of trade. From this cause, then, the late money pressure may have lasted a shorter time than it would under other circumstances.

Influence of the Price of Cotton on the Value of Slaves.—Again: the rise in the price of cotton has most undoubtedly given an impulse to the price of slaves. Cotton is the great agricultural staple throughout almost the whole of our southern slave-holding states, and consequently the marketable value of slaves will ever be determined by the value of the principal product of their labor. In Virginia and Maryland the price of slaves will always depend upon the external demand, and not on their intrinsic value in those two states.

If the price depended on the real demand arising among themselves, I doubt whether those states could afford to raise them even, so little would be their marketable value.

But there is another cause which I believe at *this moment* is operating in raising the price of slaves, and will exert a still more powerful influence in future. I mean the *late emancipation of the slaves in the Brit-*

ish West Indies. That act is certainly indefensible upon every ground of expediency, morality, and religion, but its impolicy appears most glaring when considered in a politico-economical light. Now, whatever may be said about the relative efficacy and value of free and slave labor, there is no question but that free labor, produced by sudden emancipation of slaves, is the most worthless and inefficient labor in the world. Let us take upon this subject the testimony of one who has favored emancipation in the West Indies, and who has already reaped some of the fruits of his folly. Lord Brougham, in his *Colonial Policy*, says, "The free negroes in the West Indies are, (with very few exceptions, chiefly in the Spanish and Portuguese settlements,) equally averse to all sorts of labor which do not contribute to the supply of their immediate and most urgent wants. Improvident and careless of the future, they are not actuated by that principle which inclines more civilized men to equalize their exertions at all times, and to work after the necessaries of the day have been procured, in order to make up for the possible deficiencies of the morrow. Nor has their intercourse with the whites taught them to consider any gratification as worth obtaining, which cannot be procured by slight exertion of desultory and capricious industry." The report of the committee of the Privy Council of Great Britain in 1788, of Mr. Braithwaite, the Agent for Barbadoes, and of M. Malouet, who bore a special commission to examine the habits and character of the Maroons in Dutch Guiana, all agree in asserting that free negroes are idle and worthless, and will never provide for the morrow with the foresight of civilized beings. The latter, M. Malouet, says: "Le repos et l'oisivete sont devenus dans leur etat social leur unique passion." Does not our own experience in this country prove the truth of his assertion? Do we not find the free negro the pest of the society wherever he is seen? He is the same idle, worthless creature in the north as in the south and west of our country. Have not the colonies at Sierra Leone and Liberia most conclusively proven the same fact? Does not the example of St. Domingo, which is now but a wreck of its former self, speak volumes on the same subject? Well, then, with all these facts and evidences before them, what could British statesmen have foreseen from the emancipation of slaves in the West Indies, but idleness and worthliness of the whole population? and is not this actually the result? Do not all the statements agree in asserting, that the system of apprenticeship has failed to realise the anticipated advantages? and the state of things will be still more deplorable if ever the negro shall obtain his perfect liberty. Now, what will be the consequence of all this? Why, that the British West Indies will soon cease to produce sugar for exportation, and will therefore throw the monopoly of its production into the hands of the slave-holding islands, and of Louisiana and the Floridas in our own country; and this will contribute at once to a rapid rise in slave property.

When St. Domingo was first liberated, the imaginations of mere speculative statesmen led them to behold a belt of black republics stretching through the West India Islands, diffusing their moral influence by commerce and social intercourse throughout the habitable globe. Now, what was the fact? Why, that St. Domingo was soon found to have such an idle, worthless population in her newly emancipated blacks, that her commerce was at once destroyed. She has entirely ceased to export sugar, although formerly the most productive sugar-growing island in the world. Under these circumstances, to talk of moral influence is perfectly absurd. Those black islanders have been, by the effects of their own laziness and vices, as effectually cut off from the rest of the world as if St. Domingo had been enclosed by Bishop Berkeley's forty-foot wall of brass. The London Quarterly Review, in one of its most powerful articles, asserts that nothing but the condition of St. Domingo would have enabled the British West Indies to have borne the oppression of the mother country as long as they did; that St. Domingo being thrown out of the competition in the production of sugar, gave a sort of monopoly to the British islands which enabled them to bear the oppressive regulating legislation of the Parliament. Provided we are let alone by the busy meddling philanthropists, who can attend to every body's business but their own, every negro that gets his liberty in the West Indies, or in South America, will contribute to a rise, upon precisely the same principles, in slave property in our country. The liberation of the slaves in the British West India islands is already producing that effect. If the French, Spaniards, Portuguese, Danes, &c. shall be unwise enough to follow this lead, the southern states of our Union will most assuredly reap the benefit; and if Brazil, too, should follow the example, the effect would be almost complete. It would give us a monopoly in both sugar and cotton. Sugar is not made by free labor any where in the world. Even in China, all the sugar and cotton districts are cultivated by slave labor, which in my opinion has set to rest forever, in warm countries, the question about the relative

advantages of free and slave labor. The cultivation of sugar requires a great deal of hard labor, which can be expected of the slave alone. In warm countries the principle of idleness triumphs over that of accumulation, and hence slave labor is universally the most efficient in warm and tropical latitudes. If all the slaves in the West Indies shall ever be liberated, Louisiana will become an *Eldorado.*

Effect of the Rise of the Price of Cotton and Slaves, on Corn, Wheat, Tobacco, &c.—The rise in the price of cotton and of slaves is of itself calculated to give an impulse, not only to all the agricultural products of the south, but of the north and west likewise, particularly of the west. Corn, which is the great staple of the middle states, is soon raised in value by high prices for cotton; because all the southern country, which is better adopted to the raising of corn than the middle states, raise cotton exclusively, and thus become purchasers of corn. The cultivation of cotton likewise gradually extends itself even into the middle states, and thus diminishes the quantity of corn raised still farther. In addition to these circumstances, there has been a deficient corn crop for the last two years, in consequence of distressing droughts in the latter part of the season, and too much rain in the commencement. Now, we must recollect that in any necessary of life, like corn, whose price is dependent on the home demand, if a deficit occur, the price will rise generally more than in proportion to the deficit.

The high price of cotton and corn will quickly communicate itself to horses, mules, hogs, cattle, &c., which constitute the great staples of the west; for with corn and cotton high, the middle and southern States will cease in a measure to rear those animals, and consequently will become purchasers. Wheat and tobacco, depending mostly on the foreign market, will not be so much affected. But as ours is the principal tobacco growing country for all Europe, and as an extension of the cultivation of corn and cotton has a tendency to diminish that of tobacco, it is evident that tobacco would be more influenced than wheat by a rise in the price of cotton and corn. Accordingly we find that tobacco is now selling very high. The high price of cotton is likewise calculated to make the south a better market for all the products of the north, and to give increased activity to the commercial interest, in which the north possesses the deepest stake. Mr. Lee, the author of the celebrated Boston Report on the Tariff, and one of the best statists which this country can boast of, estimated the advantage flowing to the north from the transportation of the cotton of the south, as equal to $5,000,000 on cotton, amounting in value to $25,000,000.

Summary of the Causes of the Present Prices.—Thus have I rapidly sketched out the causes which have been operating in producing the present prices. In the first place, the late removal of the deposites, and the consequent caution and curtailment of business on the part of the Bank of the United States, together with the unfriendly relations existing between that bank and the state banks, which imposed the necessity of a similar curtailment on the latter, gave a shock to public and private credit, which plunged the country into the greatest distress, and rendered the circulating medium scarce every where, by both diminution of quantity and of the rapidity of circulation. This at once brought down prices to a minimum. The importation of the precious metals from abroad was the immediate consequence of lowness of prices, and tended to relieve the pressure by increasing the currency. By and by, the banks that rode safely through the storm, began, when things settled down, to enlarge their business, confidence and credit were restored, and a redundant circulating medium is the consequence. This of itself is capable of producing high prices, independent of other causes; but in the present instance, it has been aided by the great foreign demand for cotton, which, together with the emancipation of slaves in the British West Indies, has made slaves rise in value throughout our slaveholding country. It has indirectly contributed to the high prices of corn, tobacco, and the staples of the west, and will no doubt, if it continues, diffuse prosperity over all the northern states, in the way I have already explained.

Prospects.—In the mean time, let me ask what are our prospects? I answer, that this rise in prices has already excited a rage for speculation, which will, in all probability, carry up prices still higher. A fever for speculation, when once excited in the body politic, always produces, both economically and morally, the most disastrous consequences. It destroys that regular persevering industry by which alone a nation can be enriched. It attracts the capital and resources of the country towards chimerical projects and airy bubbles. During the prevalence of the South Sea scheme in England, hundreds of projects were set on foot, and the sums proposed to be raised by these expedients amounted to more than $300,000,000, which exceeded the value of all the lands in England. On these occasions, so intoxicated do the people become with a spirit of adventure, that they fall victims to the grossest delusion. Only call it a joint

stock company, and thousands of dollars instantly flow into the scheme. All are anxious to enrich themselves by a single stroke of good fortune. The hard-working, plodding man, is looked upon with contempt. Habits of the most luxurious and vicious character are speedily introduced. There is nothing more true than the old adage, "*easy come—easy go.*" A man who makes a fortune at a stroke, is almost sure to spend it extravagantly. He must live high, and give costly entertainments, to purchase the attention and consideration of the new circle into which his wealth has just introduced him. The great merchants, lawyers, physicians, &c. follow the example which is set by the speculators—a reckless, profligate, gambling spirit, is spread through the country—one half the nation is trying to grow wealthy by the ruin of the other half. Every kind of deception, falsehood, and trickery, are resorted to for the purpose of influencing the markets. "During the infatuation produced by this infamous scheme, (South Sea,)" says the historian, "luxury, vice, and profligacy, increased to a shocking degree of extravagance. The adventurers, intoxicated by their imaginary wealth, pampered themselves with the rarest dainties, and the most expensive wines that could be imported; they purchased the most sumptuous furniture, equipage, and apparel, though without taste or discernment; they indulged their criminal passions to the most scandalous excess; their discourse was the language of pride, insolence, and the most ridiculous ostentation; they effected to scoff at religion and morality, and even to set heaven at defiance." A bill was actually brought into the British Parliament for the suppression of blasphemy and profaneness, to so fearful a degree had the spirit of speculation and gambling effected the morals of the people.

The disastrous influence of this rage for speculation in our own country, during 1817, 1818, and part of 1819, was almost as great as that produced in England by the celebrated South Sea bubble, or in France by the Mississippi scheme.

With regard to Virginia, I do not think the mania will be so apt to reach her in its most aggravated form: the high price of negroes and cotton, now producing a fearful emigration to South West, where golden harvests will be realized, if present prices can only be kept up, the spirit for speculation will in a great measure direct itself towards south-western lands. Hence, although corn, wheat, and tobacco, may rise, this exhausting drain of our labor and capital to the south-west will keep land in this state from rising *pari passu*. Our labor and capital both are swept from our soil as fast as accumulated. At this moment in Virginia, there is a mighty struggle going on between the elastic principle of the black population on the one hand, and the drain to the south-west on the other. And if the high price of slaves shall be kept up for a few more years, I doubt whether all the procreative energies of the race can compensate for the emigration; and in that event we shall be obliged to fill up with Irishmen and northern laborers, or leave the soil of the state comparatively stript of labor. In the mean time, however, let us preserve our sobriety, our industry, and our morality, enjoying the present advantages of high prices, without rushing into schemes and adventures of a wild and reckless character, under the vain belief that these times are to last forever. Sooner or later, if prices rise above the natural level, they must come down by a process which I have already pointed out. If cotton shall fall speedily, or if a superabundant corn crop shall be made this year, these extravagant prices would be checked at once. And we must recollect, too, that the Bank of the United States is quickly to wind up, and if its curtailment shall be very rapid, it may force the whole banking system of the country to contract its accommodation, and thus, perhaps, to give a shock once more to public confidence. At all events, let us remember the moral of the famous epitaph—"I was well—I wished to be better—and here I am."

May 21, 1835.

[From the American Railroad Journal.]

FOOT RAILROADS.

It is proposed to show in this article, that railroads for short distances may be used to advantage by men to transport themselves and moderate loads by their own strength.

1. In showing this, I may first state the force of traction required on railroads. The force of traction is measured by a weight suspended to a cord passing over a pulley. The traction, or tractive power of a horse, is said to be 125 pounds, because a horse at his ordinary labor draws with a force sufficient to raise up 125 pounds by a cord over a pulley. The tractive power necessary to move waggons on common roads, and cars on railroads, has been very accurately ascertained. If a waggon with its load weighs 2400 pounds, then, if a weight of 200 pounds is suspended to a cord passing over a pulley, which cord draws the waggon, this weight would move the waggon forward on a good level turnpike road. But a car on a level railroad, weighing with its load 2400 pounds, would be moved forward by a weight of only ten pounds, suspended to a cord running over a pulley. If then a man

could draw up a weight of ten pounds, he could, with the same rapidity that it ascends, move forward, on a level railroad, a car and its load weighing together 2400 pounds. If he could draw ten pounds up ten feet in a second, he could move the car and its load ten feet in a second; and if he could do this for an hour in succession, he could then move forward the car and its load 3600 feet in the hour. But if the railroad rises but 22 feet in a mile, the traction of 10 pounds will not move 2400 pounds up this ascent; but the traction of 10 pounds must be added, or the traction of 20 pounds will be needed; and if the ascent is 44 feet in a mile, another additional traction of 10 lbs. must be made, or there must be a traction of 30 pounds. The traction of 10 pounds, at 10 feet in a second, might be made to operate on a car 20 feet in a second; but the traction of ten pounds would not move a car weighing 2400 pounds 20 feet in a second, for it would propel only half the weight, or 1200; and if the traction of 10 pounds, at 10 feet in a second, were made to move a car 40 feet in a second, it would propel a car at this rate weighing only 600 pounds. With the same power with which a weight of 2400 pounds is moved forward on a level railroad 3600 feet, a weight of 600 pounds might be propelled four times that distance, or 14,400 feet.

2. What now is the power ordinarily exerted by a laboring man? Different estimates are made of this power. By Dr. Farey, a recent writer on the steam engine, the power of man is assumed to be equal to the raising of 60 cubic feet of water, which is equal to 3750 lbs. avoirdupois, through the space or height of one foot in a minute. A stout laborer, says Dr. Farey, will continue to work at this rate during eight hours per day. The relative values of the labor of a man and a horse, as to physical strength exerted, are variously stated. Some estimate them as 1 to 5, some as 1 to 6, and some as 1 to 7. The efforts of men differ with the manner in which these efforts are employed. It has been estimated by Mr. Buchanan, that the same quantity of human labor employed in working a pump, turning a crank, ringing a bell, and rowing a boat, are as the numbers 100, 167, 227, 248. The strength of man could be applied in the most economical way on a railroad, and so as to act with even more efficiency than in rowing a boat. He might sit in a reclining posture like a man pulling an oar, with his feet pushing against the flat boards of a small wheel, and by his hands drawing upon the slats of a drum wheel, instead of drawing upon an oar, while the wheel on which his feet operate, and that on which his hands operate, act on the same working point. This machinery might occupy but about the space filled by two chairs, or very little more than is required by one man to sit at his ease.

Attempts have been made to construct carriages by which a man might propel himself on common roads; but a knowledge of the power of traction necessary on common roads, would show that this is wholly impracticable. If a man's weight is 175 pounds, it would require an additional tractive power of 14½ to move himself on a common road, while this additional power would of itself alone move forward on a level railroad 3480 pounds; but for a man to move himself forward on a level railroad would require an additional traction of only two thirds of a pound, if his weight is 175 pounds.

If a laboring man ordinarily exerts strength sufficient to raise 3750 pounds 10 feet high in a minute, then he could propel 3750 pounds 240 feet in a minute, or half a mile in 12 minutes; or he could propel 937 pounds one mile in six minutes, or ten miles in an hour, and do this for eight hours in a day.

3. The attention may now be directed to the various occasions persons have to go, or to carry goods for short distances. Among the new and striking circumstances that in the city arrest the visitor from the country, is the throng of carts, and carriages, and horses, crowding the streets, and stunning his ears. This fact shows that there is a vast amount of conveyance of persons and loads from one part of a city to another. While such an amount of transportation is demanded by the necessities and convenience of the people of a city, it is manifest that railroads along some principal streets, reducing the freight of goods and persons to one tenth, or one third of its present cost, would be an immense gain to the community. The result would be that much mechanic business needed in a city would be done at a distance, where there was more room, and where on many accounts it could be done to more advantage. By the railroad the mechanic would be as near his customers four miles off, as he is now one third of a mile. From a centre of business a man might transport himself with great ease several miles for his food and lodging, since, as easily as he would walk up stairs, or up a hill, 22 feet, with two pounds weight in his hand, he could move forward a mile on a level railroad, transporting himself, whatever is his weight, and moving his car also weighing 480 lbs. Or, supposing that it is about as fatiguing to a man to walk at the rate of three miles an hour, as to work for that time with the strength of a laboring man, then, as easily

as he could walk one mile to his lodgings or home, he could propel himself and car, weighing together 625 pounds, $4\frac{1}{4}$ miles on a level railroad, and in the same time that he could walk a third of a mile. In the country an immense advantage would accrue from light and cheap railroads to centres of business, to get to stores, to physicians, to schools, to public lectures, and meetings, and to religious assemblies.

The influence of such means of communication on intellectual, moral, and religious improvement, I would set above all other advantages. The greatest mental and moral debasement is found in remote country neighborhoods, and in dark city lanes, and their deep cellars.

4. The position of places of business is ordinarily such that they can be accommodated to a great extent by level railroads. Cities are commonly built on navigable waters; and the business in them is done along a water line, and here are ranged the workshops and stores. Railroads from the country will naturally terminate on this level, for they must be kept on low ground, and in the vallies of streams, which keep the lowest and most level courses. The railroads from Providence and Worcester terminate in Boston at what was once the neck, from whence very level rail paths might extend to the principal wharves, and indeed around the whole city. Rail tracks, extending from the termination of these railroads over the city, would greatly promote the success of the railroads, for, on a level track, a horse might draw several cars and loads, weighing together 12 tons. A car might receive the passengers directly from the steamboat, or travellers might enter one at their hotel, and without being delayed by the long process of getting seated at the head of the railroad, the cars, all loaded, might meet almost at the minute from different quarters, and pursue their course without hindrance.

Slight and cheap lines of railroad for the application of human power, intersecting the city and country, will accommodate especially the great body of the middling and poor classes, and may thus do as much good as the grand and heavy railroads, on which the ponderous cars of three and four tons weight are rolling; and they may add vastly to the business of these main channels of communication. If there are to be conveyed loads of 50, 100, 200, or 500 pounds, porters could convey them as easily on their light cars on rail tracks, as they could walk on a common road without any burden. To draw a load of 480 lbs. a man has to exert only the power that would raise two pounds over a pulley; and to move himself also on his load, he would have to exert only the additional tractive power of one-third of a pound. The effect of cheap rail tracks would be as though a railroad terminated at each man's door.

By these facilities of communication, both the country and the town would be benefitted. Labor is nearly double in the city what it is in the country; and this is a loss to the laborer and the employer. It is a loss to the employer, because the labor he gets costs him so much; and it is a loss to the laborer, because his expenses are great and his accommodations poor. It is a loss also to the laborer in the country, because he cannot get the products of his labor to market without losing a great part of their value. The expense of transportation is a dead loss to the public; and by how much this expense is reduced, by so much is the whole public benefitted.

PUBLICOLA.

[From the American Railroad Journal.]

On the Location of Railroad Curvatures; being an Investigation of all the Principal Formulas which are required for Field Operations, in laying Curves and Tangent Lines, to pass through Given Points. By J. S. VAN DE GRAAFF.

(Continued from vol. vi., page 36.)

24. When the given curve ADF, (see fig. art. 23,) has been actually traced in the field, the co-ordinates x, y, have to be computed by means of (VII.) in order to obtain the distance FR, as proposed in the last article. In such a case, *if the two moduli of curvatures* T *and* T′ *be equal to each other*, the distance FR and the angle P will be more conveniently had by means of a direct formula in terms of n, m, T, and $\propto$, without first computing the values of the co-ordinates x, y, and x', y'. For when (XXIII.) is developed, agreeably to the common principles of algebra, the result is, $w = (x^2 + y^2 + x'^2 + y'^2 - 2xx' - 2yy' - 2\propto . \overline{x'-x} + \propto^2)^{\frac{1}{2}}$; and by substituting in this equation for x, y, and x', y', their values obtained from (VII.), upon the supposition that $T = T'$; suppressing the quantities which cancel each other, and reducing the result, agreeably to the principles of analytical trigonometry; the following formula will be then obtained:

$$w = \left\{ \frac{1 - \text{Cos.}(2nT - 2mT)}{1 - \text{Cos.}2T} - \propto \times \frac{\text{Sin.}2mT - \text{Sin.}2nT}{\text{Sin.}T} + \propto^2 \right\}^{\frac{1}{2}} \quad (\text{XXV.})^*$$

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* When $2m\text{T} > 2n\text{T}$, then $2n\text{T} - 2m\text{T}$ becomes a *negative* quantity. It must, however, be remembered that *negative arcs*, which are less than 90°, have *positive cosines*. The quantity $\text{Sin.}2m\text{T} - \text{Sin.}2n\text{T}$, will be negative when the latter *sine* is the greatest.

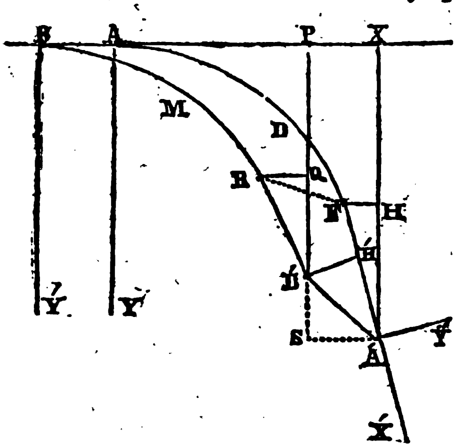
The *sign* of the quantity $\propto$, is here supposed to be

Thus, an expression for the value of w has been obtained, which will be quite convenient for use in the field, with the table of *natural* sines and cosines, and the table of the squares and square roots of numbers, subjoined to this volume. But the values of the co-ordinates x, y, and x', y', not being here computed, a new formula will be required for determining the angle P. For this purpose it will be only necessary to substitute in $\text{Cos. P} = \dfrac{x' - x - \propto}{w}$, the valves of x' and x, as obtained from (VII.) The following expression will be then obtained:

$$\text{Cos. P.} = \frac{\dfrac{\text{Sin.}2m\text{T} - \text{Sin.}2n\text{T}}{2\text{Sin.T}} - \propto}{w}. \quad \text{(XXVI.)}$$

A formula expressing the value of Cos. P, has been here selected in preference to one for the value of Sin. P, for the obvious reason that the principal term in the numerator of (XXVI.) is had by simply dividing by 2, one of the quantities in (XXV.), whose value will always be previously known from the computation of w. But with regard to the *sign* of sine P, it may be observed that, in the case here under consideration, Sin. P will always be *positive* when $n - m$ is *positive*; and vice versa.

If in (XXV.), it be supposed that $n = m$, the result is, $w = \propto$. That is, *the distance between the two curves, in a direction parallel to the common tangent at the origins, is always the same constant quantity* $= \propto$. See art. 11.



25. Suppose ADF to represent a given curve, and BMR another proposed curve laid upon the same tangent line AX, and let $\propto$ denote the given distance AB, between their origins. Take T and T', to represent the given moduli of curvatures; and let each curve pass into a tangent, FA', and RB', at the extremity of the nth and mth chain respectively. Let the number of chains contained in each tangent be denoted by v and v' respectively. It is then required to determine the distance A' B', between the extremities of those two tangents. And taking A' X', A' Y', for a system of rectangular co-ordinate axes, coinciding with the given origin A', and tangent line A' F, it is proposed to investigate expressions for the values of the co-ordinates A' H', H' B', of the point B'.

The first thing which will be required, in the present inquiry, is the value of each of the co-ordinates AX, XA', and BP, PB', of the two points A' and B', estimated from the primitive axes AX, AY, and BX, BY'. Let those co-ordinates be represented by X, Y, and X', Y', respectively. The following equations will then evidently exist, $\begin{cases} \text{X} = x + \text{FH} \\ \text{Y} = y + \text{A'H} \end{cases}$; but by (IV.), $\angle$HFA' $= 2n$T, and therefore by the principles of trigonometry, FH $= v\cdot$ Cos. $2n$T, A'H $= v\cdot$ Sin.$2n$T. The following formulas will therefore be the result:

$$\begin{aligned} \text{X} &= x + v\cdot \text{Cos.}2n\text{T} \\ \text{Y} &= y + v\cdot \text{Sin.}2n\text{T}. \end{aligned} \quad \text{(XXVII.)}$$

And in like manner the following similar equations may be obtained:

$$\begin{aligned} \text{X}' &= x' + v'\cdot \text{Cos.}2m\text{T}' \\ \text{Y}' &= y' + v'\cdot \text{Sin.}2m\text{T}'. \end{aligned} \quad \text{(XXVIII.)}$$

Now, taking W to denote the required distance A'B', its value will obviously be expressed in the following manner:

$$\text{W} = \left\{ \overline{\text{X} + \propto - \text{Y}'}|^2 + \overline{\text{Y} - \text{Y}'}|^2 \right\}^{\frac{1}{2}} \quad \text{(XXIX.)}$$

The theorems (XXVII.) will frequently find an application in the field, as a means of investigating particular cases which will occur where tangents are concerned; and in every case in which the line A' B' is required to be known, its value cannot be computed by any other method with more ease than by (XXIX.), a table of the squares and square roots of numbers being at hand.

It will sometimes happen that the point B' is required to be the origin of a new curve, whose modulus of curvature must be found by means of data furnished from another curve *previously computed,* or actually traced, from the origin A', and axes A' X', and A' Y''; and in such a case, the co-ordinates A' H', H' B', furnish the most convenient data for computing the new curvature, which was fully explained in article 22.

Put, $\propto' =$ A' H', and $\beta' =$ H' B'; and for the sake of convenient notation, take $k =$ X $+ \propto -$ X' $=$ S A', and $h =$ Y $-$ Y' $=$

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subject to the same *conditions* as in (XXIII.), and (XXIV.); and the same thing, in all cases, must be hereafter understood.

S B′. It is obvious that, $\angle$ S A′ H′ — 2 n T, and $\angle$ S B′ H′ = 180° — 2 n T; and therefore, agreeably to a well known theorem in plane trigonometry,* a diagonal from S to H will be expressed either by

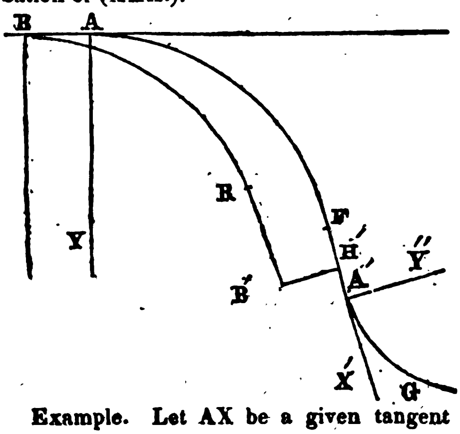
$$\overline{k^2 + \alpha'^2 - 2k\alpha' . \text{Cos. } 2n\text{T}}|^{\frac{1}{2}},$$

or by $\overline{h^2 + \beta'^2 + 2h\beta' \cdot \text{Cos. } 2n\text{T}}|^{\frac{1}{2}}$;

these two quantities are therefore equal, and consequently recollecting that $\alpha'^2 + \beta'^2 = h^2 + k^2$, the result will be $\alpha'^2 - h^2 = k\alpha' \cdot \text{Cos. } 2n\text{T} + h \cdot (h^2 + k^2 - \alpha'^2)^{\frac{1}{2}} \cdot \text{Cos. } 2n\text{T}$; that is, $\overline{\alpha'^2 - h^2}|^2 + k^2 \alpha'^2 \cdot \text{Cos.}^2\ 2n\text{T} - 2k\alpha' \cdot (\alpha'^2 - h^2) \cdot \text{Cos. } 2n\text{T} = h^2 \cdot (h^2 + k^2 - \alpha'^2) \cdot \text{Cos.}^2\ 2n\text{T} = h^2k^2 \cdot \text{Cos. } 2n\text{T} - h^2 \cdot (\alpha'^2 - h^2) \cdot \text{Cos.}^2\ 2n\text{T}$; or, $\overline{\alpha'^2 - h^2}|^2 - 2k\alpha' \cdot (\alpha'^2 - h^2) \cdot \text{Cos. } 2n\text{T} = - k^2 \cdot (\alpha'^2 - h^2) \cdot \text{Cos.}^2\ 2n\text{T} - h^2 \cdot (\alpha'^2 - h^2) \cdot \text{Cos.}^2\ 2n\text{T}$; that is, $\alpha'^2 - h^2 - 2k\alpha' \cdot \text{Cos. } 2n\text{T} = - (h^2 + k^2) \cdot \text{Cos.}^2\ 2n\text{T}$; and this equation is now easily reduced, by the method of quadratics, to the form, $\alpha' - k \cdot \text{Cos. } 2n\text{T} = h \cdot \text{Sin. } 2n\text{T}$. By pursuing the same method with regard to β', a similar result will be obtained; and thus the formulas which it was proposed to investigate are the following:

$$\alpha' = k \cdot \text{Cos. } 2n\text{T} + h \cdot \text{Sin. } 2n\text{T}$$
$$\beta' = k \cdot \text{Sin. } 2n\text{T} - h \cdot \text{Cos } 2n\text{T}. \quad \text{(XXX.)}$$

It is easy to see that the expressions just obtained might have been deduced with more facility immediately from (XXI.); but a special investigation was considered preferable. The following case may be assumed, in order to show a practical application of (XXX.).



Example. Let AX be a given tangent line, and A the given origin of a curve. From the origin A, and parallel to the axes AX, AY, let a system of rectangular lines be traced to a certain designated point F, selected in such a manner as to give an *integer* number of chains in the curve AF, agreeably to the method explained in art. 17; and let the values of T, n, x, and y, as deduced therefrom, be, T = 2° 3′, n = 18 chains, x = 13·40 chains, and y = 10·08 chains. From the point F suppose a tangent FA′ to be laid 9 chains, agreeably to the method explained in art. 16; and from the point A′, as a new origin, and parallel to the rectangular axes A′ X′, A′ Y″, let a second system of rectangular lines be traced, terminating in a certain designated point G, and let the resulting equations give $\left\{ \begin{array}{l} x = 10\cdot \\ y = 10\cdot \end{array} \right\}$ chains, agreeably to art. 16. Now, having computed the modulus of curvature of A′ G, and examined the direction at G, suppose it be found, in consequence of the particular situation of the ground from A′ to G, to be advisable to change the origin of the curve AF to a point B, 4 chains *back* upon the tangent line AX, and from thence to lay a curve BR, from the same modulus of curvature, for a distance of 15 chains to the point R; and then a tangent RB′ for a distance of 12 chains to the point B′. It is then proposed to know what modulus of curvature will trace a curve from the tangent line RB′, and from the origin B′, passing through the same designated point G.

In such a case as the present, the co-ordinates x', y', X′, Y′, and X, Y, of the points R, B′, and A′, respectively, will most generally have been already computed in making a proper selection of the points R and B′, before any calculation is wanted with regard to the modulus of curvature of the required curve from B′ to G. But to show an example in figures, of the manner of obtaining those co-ordinates, the given data at present are, T = 2° 3′, n = 18, x = 13·40, y = 10·08, v = 9, T′ = 2° 3′, m = 15, and v' = 12. Hence, 2nT = 73° 48′, 2mT′ = 61° 30′; and by (VII.), $x' = \frac{\text{Sin. } 61° 30'}{2\text{Sin. } 2° 3'} = \frac{\cdot 87882}{\cdot 07154} = 12{\cdot}28$, $y' = \frac{1 - \text{Cos. } 61° 30'}{2\text{Sin. } 2° 3'} = \frac{\cdot 52284}{\cdot 07154} = 7{\cdot}31$; and by (XXVII.), X = 13·40; + 9 × Cos. 73° 48′ = 13·40 + 9 × ·279 = 13·40 + 2.51 = 15·91, Y = 10·08 + 9 × Sin. 73° 48′ = 10·08 + 9 × ·960 = 10·08 + 8·64 = 18·72; and by (XXVIII.), X′ = 12·28 + 12 × Cos. 61° 30′ = 12·28 + 12 × ·477 = 12·28 + 5·73 = 18·01, Y′ = 7·31 +

* This theorem is sometimes wanted in the field, and it may therefore be convenient to have it expressed here, in the usual form. Take a, and b, to denote any two sides of a plane triangle, and let X represent the *contained* angle, and x the opposite side. Then

$$x^2 = a^2 + b^2 - 2\,a\,b\,.\text{Cos.X}.$$

$12 \times$ Sin. $61° 30' = 7 \cdot 31 + 12 \times \cdot 879 = 7 \cdot 31 + 10 \cdot 54 = 17 \cdot 85$. We now have $k = 15 \cdot 91 + 4 \cdot 00 - 18 \cdot 01 = 1 \cdot 90$, $h = 18 \cdot 72 - 17 \cdot 85 = 0 \cdot 87$; and by (XXX.), $\propto' = 1 \cdot 9 \times \cdot 279 + \cdot 87 \times \cdot 960 = \cdot 53 + \cdot 84 = 1 \cdot 37$, $\beta' = 1 \cdot 9 \times \cdot 960 - \cdot 87 \times \cdot 279 = 1 \cdot 62 - \cdot 24 = 1 \cdot 58$, which are therefore the values of the co-ordinates of the new origin B′; and thus the required modulus of curvature is readily found, by means of (XXII.), to be $= 1° 56'$.

It will sometimes be very convenient in the field, to determine by measurement the values of the co-ordinates, A′ H′, H′ B′, of the new origin B′, after the new line BRB′ has been traced up to the point B′.

26. Let the characters $\propto$, n, m, T, and T′, represent the same things as in the preceding article, and suppose the conditions with relation to the curves ADF, and BMR, to remain. Produce the two tangents FA′, and RB′, until they intersect each other; and take v, and v', to denote the number of chains in each respective tangent to their common point of intersection, and let z represent the angle of intersection. It is then proposed to investigate the general equations which subsist among those various quantities, in order that, when the circumstances in the field are such as to make any one of the quantities $\propto$, m, T′, v', or z, unknown, that quantity may then be eliminated, and its value obtained.

The first equation which will be required, in the investigation of any case where the *intersection* of two tangents is concerned, may be immediately deduced from (V.), and is expressed as follows:

$$2n\text{T} - 2m\text{T}' - z = 0. \quad \text{(XXXI.)}$$

And thus any one of the three quantities m, T′, or z, will be made known, when the *other two* are given, or assumed in such a manner as the situation of the ground may require. If, however, z be a quantity whose value is given, and fixed by particular circumstances in the field, then the value of T′ should generally be taken in such a manner as to give m an integer number, when eliminated from the equation $2n\text{T} - 2m\text{T}' - z = 0$.

The second subject of inquiry will now be an investigation of such equations as express the relations which exist between the quantities $\propto$, v, and v'. In the case here under consideration, it is evident from (XXIX.), that $\overline{\text{X} + \propto - \text{X}'}|^2 + \overline{\text{Y} - \text{Y}'}|^2 = 0$; and therefore, agreeably to the principles of algebra, $\text{X} + \propto - \text{X}' = 0$, and $\text{Y} - \text{Y}' = 0$; that is, $\propto + x + v \cdot \text{Cos. } 2n\text{T} - x' - v' \cdot \text{Cos. } 2m\text{T}' = 0$, and, $y + v \cdot \text{Sin. } 2n\text{T} - y' - v' \cdot \text{Sin. } 2m\text{T}' = 0$. From the last of these two equations, let the value of v' be obtained, and substituted in the first. The result is, $\propto \cdot \text{Sin. } 2m\text{T}' - v \cdot \text{Sin. } z + \overline{x - x'} \cdot \text{Sin. } 2m\text{T}' - \overline{y - y'} \cdot \text{Cos. } 2m\text{T} = 0$; and in like manner, $\propto \cdot \text{Sin. } 2n\text{T} - v' \cdot \text{Sin. } z + \overline{x - x'} \cdot \text{Sin. } 2n\text{T} - \overline{y - y'} \cdot \text{Cos. } 2n\text{T} = 0$. But by (VII.), $x - x' = \dfrac{\text{Sin. } 2n\text{T}}{2 \text{ Sin. T}} - \dfrac{\text{Sin. } 2m\text{T}'}{2 \text{ Sin. T}'}$, and, $y - y' = \dfrac{1 - \text{Cos. } 2n\text{T}}{2 \text{ Sin. T}} - \dfrac{1 - \text{Cos. } 2m\text{T}'}{2 \text{ Sin. T}'}$; which values being substituted in the last equations, and the obvious reductions made, the two following equations will result:

$$\propto \cdot \text{Sin. } 2m\text{T}' - v \cdot \text{Sin. } z + \frac{\text{Cos. } z - \text{Cos. } 2m\text{T}'}{2 \text{ Sin. T}} - \frac{1 - \text{Cos. } 2m\text{T}'}{2 \text{ Sin. T}'} = 0;$$

$$\propto \cdot \text{Sin. } 2n\text{T} - v' \cdot \text{Sin. } z - \frac{\text{Cos. } z - \text{Cos. } 2n\text{T}}{2 \text{ Sin. T}'} + \frac{1 - \text{Cos. } 2n\text{T}}{2 \text{ Sin. T}} = 0.$$

(XXXII.)

Such is the second system of equations which will be required in the field.* The following cases may be given to illustrate their application:

Case I. When v, z, and T′, are *given*, to find $\propto$.

Here, by an evident transposition of the first of the equations (XXXII.), the following formula is obtained:

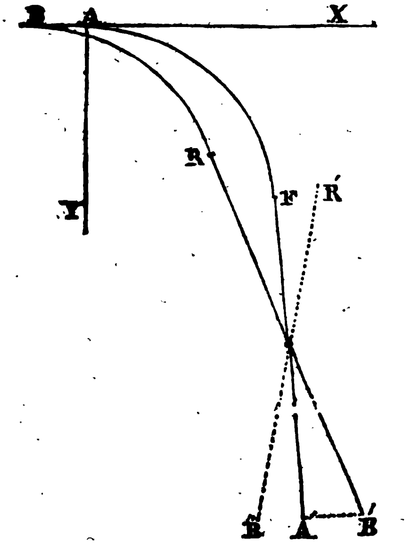
$$\propto = \frac{v \cdot \text{Sin. } z + \dfrac{1 - \text{Cos.} 2m\text{T}'}{2 \text{ Sin. T}'} - \dfrac{\text{Cos.} z - \text{Cos.} 2m\text{T}'}{2 \text{ Sin. T}}}{\text{Sin. } 2m\text{T}'}.$$

(XXXIII.)

And the quantity $\propto$ thus becomes known; for the value of m may be obtained from (XXXI.). In every instance in which this case will occur in practice, such a value may be selected for T′, as will give m an integer number, without doing any injury to the line.

Example 1. Let AX be a given tangent line, and A a given point therein, selected for the origin of a curve. By means of a system of rectangular lines, traced from the origin A, and parallel to the axes AX, AY, let a certain point F be designated, as the situation of the ground may seem to require, and in such manner as to coincide with the extremity of the 25th chain of a curve AF, whose modulus of curvature is 1° 30′, agreeably to the method explained, art. 17. From the point F, let a tangent FA′ be traced 60 chains, agreeably to the principles given in art. 16; and from the point A′ trace the rec-

* In order to avoid misapprehension and error, particular attention must be paid to the sign of the angle z, which, in all cases where $2m$T′ exceeds $2n$T, is to be made negative; or, the angle z is to be accounted negative, when the tangent v' is more inclined than v, to the common tangent at the origin.



tangular ordinate A′ B′, 2·5 chains, to a point B′, selected in consequence of the particular situation of the ground. Now, suppose S to be a point in the tangent line FA′, 30 chains from F, through which the peculiar situation of the ground renders it desirable that a new tangent RSB′ should be laid. It is then proposed to determine the position of such a point B, in the primitive tangent AX, as will be the proper origin of a new curve BR, passing into the proposed tangent line RSB′.

It is here supposed, as the figure indicates, that the line RSB′ has an inclination, less than the line FSA′ to the common tangent AX; and consequently, in this instance, the angle z will be *positive*, and expressed by the angle A′ S B′. By plane trigonometry, $\text{Tan.}\, z = \frac{A'\,B'}{A'\,S} = \frac{2{\cdot}5}{30} = {\cdot}08333$; or, $z = 4°\ 46'$. Hence, by (XXXI.), $2m\text{T}' = 2n\text{T} - z = 75° - 4°\ 46' = 70°\ 14'$; or, $m\text{T}' = 35°\ 7'$. Now, the values of the quantities m and T' may be taken in any arbitrary manner, provided the equation $m\text{T}' = 35°\ 7'$ be satisfied. The peculiar situation of the ground, between the points A and F, must therefore *decide* the values of m and T'. The object should be to make the new curve BR as *long* as the *limits of expense* will allow; for in the same proportion as that curve is made longer, it will also be made of less abrupt curvature; but it will then diverge farther to the right of the first curve AF. Let it be supposed that the new curve BR may have a length of 20 chains; then, $\text{T}' = \frac{35°\ 7'}{20} = 1°\ 45\tfrac{1}{3}'$, which will therefore be the modulus of curvature of the new curve BR. And now, to find the necessary position of the origin B, we have, by (XXXIII.),

$$\propto = \frac{30 \times \text{Sin.}\ 4°\ 46' + \dfrac{1 - \text{Cos.}\ 70°\ 14'}{2\ \text{Sin.}\ 1°\ 45\frac{1}{3}'} - \dfrac{\text{Cos.}\ 4°\ 40' - \text{Cos.}\ 70°\ 14'}{2\ \text{Sin.}\ 1°\ 30'}}{\text{Sin.}\ 70°\ 14'}$$

That is, $\propto =$

$$\frac{30 \times {\cdot}08310 + \dfrac{{\cdot}66181}{{\cdot}06128} - \dfrac{{\cdot}99654 - {\cdot}33819}{{\cdot}05236}}{{\cdot}94108} = \frac{2{\cdot}493 + 10{\cdot}800 - 12{\cdot}573}{{\cdot}941} = \frac{+{\cdot}720}{{\cdot}941} = {\cdot}765.$$

Hence, measure the distance AB = ·765 of a chain, *back* upon the tangent line AX, and the required *origin* of the new curve BR will be obtained.

Example 2. Suppose the same data to remain as in the preceding instance, with the exception only that the position of the required new tangent R′ S B″, is reversed; that is, let the line R′ S B″ have an inclination exceeding that of the line FSA′, to the common tangent AX.

Here the angle z becomes *negative*, and therefore, by (XXXI.), $2m\text{T}' = 2n\text{T} - z = 75° + 4°\ 46' = 79°\ 46'$; or, $m\text{T}' = 39°\ 53'$. And hence, if it be supposed that the ground between the points A and F be such as to admit a new curve 40 chains in length, then $\text{T}' = \frac{39°\ 53'}{40} = 0°\ 59\tfrac{1}{3}'$ = modulus of curvature of the new curve. Now, recollecting that Sin. z becomes *negative*, and Cos. z remains *positive*, we have

$$\propto = \frac{-30 \times \text{Sin.}\ 4°\ 46' + \dfrac{1 - \text{Cos.}79°\ 46'}{2\ \text{Sin.}\ 59\frac{1}{3}'} - \dfrac{\text{Cos.}4°\ 46' - \text{Cos.}79°\ 46'}{2\ \text{Sin.}\ 1°\ 30'}}{\text{Sin.}\ 79°\ 46'} =$$

$$\frac{-\,2.493 + \dfrac{{\cdot}82234}{{\cdot}03480} - \dfrac{{\cdot}99654 - {\cdot}17766}{{\cdot}05236}}{{\cdot}98409} =$$

$$\frac{-\,2{\cdot}493 + 23{\cdot}630 - 15.637}{{\cdot}98409} = \frac{+\,5{\cdot}500}{{\cdot}984} =$$

5·59. Hence, the new origin is 5·59 chains, *back* upon the tangent line AX; and consequently, in this instance, the new *curve* will *intersect* the first curve AF.

Case II. When $\propto$, v, and z, are given; to find T'.

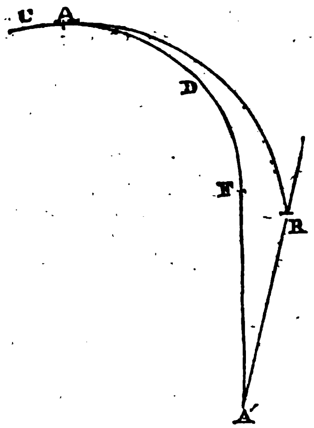
Let the quantity $2m\text{T}'$ be represented by D; and the following expression will be immediately derived from (XXXI.):

$$\text{D} = 2n\text{T} - z. \qquad \text{(XXXIV.)}$$

The value of D will be thus made known; and by an obvious transposition of the first equation (XXXII.), the following formula will then obtain:

$$\text{Sin. } T' = \frac{1 - \text{Cos. } D}{2 \propto \cdot \text{Sin. } D - 2v \cdot \text{Sin. } z + \frac{\text{Cos. } z - \text{Cos. } D}{\text{Sin. } T}} \quad \text{(XXXV.)}$$

Having computed the value of T′, the quantity m, which denotes the number of chains contained in the new curve, will be made known by the formula, $m = \frac{D}{2T'}$. This will, however, be accurately true, only when m is an *integer* number, for reasons already explained in art. 5; but the formula (XXXV.) is, nevertheless, obviously rigorous. When the formula $\frac{D}{2T'}$ does not express an *integer* number, it will be, most generally, convenient in practice to take for the value of m the nearest integer number *greater* than $\frac{D}{2T'}$; and then, after tracing every chain in the new curve *except the last*, let that last chain be laid from a modulus of curvature expressed by the formula, $\frac{1}{2} D - T' \times \overline{m - 1}$; which will restore the proper *direction* to the new tangent, agreeably to principles evident enough from (IV.), and it will not vary, laterally, any material distance from the required position.



Example. Let CADF be a curve whose modulus of curvature is 1° 30′; and let A be a station in that curve, 25 chains from the extreme station F. From F, suppose a tangent FA′ to be laid 30 chains to a point A′. It is then proposed to determine the necessary change of curvature at the station A, in order to trace a new curve AR, such as to pass into a new proposed tangent RA′, intersecting the former at the point A′, and whose inclination to the common tangent at the station A, *exceeds* that of the tangent FA, by 4° 46′.

Here, $T = 1° 30'$, $n = 25$, $v = 30$, $\propto =$ 0, and $z = -4° 46'$; therefore by (XXXIV.), $D = 2nT - z = 75° + 4° 46' = 79° 46'$. Hence, by (XXXV.), Sin. T′ =

$$\frac{\cdot 82234}{+ 60 \times \cdot 08310 + \frac{\cdot 99654 - \cdot 17766}{\cdot 02618}} = \frac{\cdot 82234}{4\cdot 986 + 31\cdot 278} = \frac{\cdot 82234}{36\cdot 264}$$

$= \cdot 02267$; or, $T' = 1° 18'$ = modulus of curvature necessary to trace the required curve AR, agreeably to the principles explained in art. 9. Now, in this instance, $\frac{D}{2T'} = \frac{79° 46'}{2° 36'} = \frac{79\cdot 767°}{2\cdot 6°} = 30\cdot 68$; which is not an *integer* number, and the new curve AR must therefore be made to consist of 31 chains, of which the first 30 will be laid agreeably to the modulus of curvature, 1° 18′. And then, $\frac{1}{2} D - T' \times \overline{m - 1} = 39° 53' - 1° 18' \times \overline{31 - 1} = 39° 53' - 39° 0' = 0° 53'$ = necessary modulus of curvature for the 31st chain.

[From Porter's Chemistry of the Arts.]

FURNACES IN GENERAL.

(Continued from page 38.)

The Chamber.—The situation of the chamber varies much, and gives certain denominations to various furnaces. In some furnaces the chamber and fire-room are united; and even in this case there are several variations, for sometimes the substances to be acted upon are mixed with the fuel, and that either in alternate beds, one on the other, as in lime and brick-kilns, or the fuel and the other materials are thrown alternately in at the mouth of the furnace, as in the blast furnaces in which iron ore is smelted. In other furnaces, the vessels containing the materials are either placed circularly round the fire next the well of the fire-room, as in glass-house furnaces, and those in which spelter is distilled, and brass made; or else the vessel is placed in the centre of the fire, and entirely surrounded with fuel on the top as well as on the sides, as in the furnaces of founders and casters of metals. This latter disposition has received amongst practical writers a peculiar denomination, namely, that of a wheel-fire, or ignis rotæ. The chamber, when it forms a separate part from the fire-room, admits of three variations; for sometimes it is over the fire-room, sometimes on the side, and

sometimes it is placed in the centre, and surrounded with several fire-rooms.

The chamber is placed over the fire-room in the furnaces used with pots, kettles, common stills, and the boilers for producing steam. These vessels in general hang down from the mouth of the chamber, which is placed directly over the fire-room, and there is a sufficient space left between the vessel and the walls of the chamber, to allow the free passage to the vent of the air that has passed through the fire. The breadth of this space is usually left to the judgment of the bricklayer; the horizontal area of it ought to be equal to that of the free space between the bars of the grate, which is the radix from whence all the proportions of the different parts of a furnace are to be calculated. Hence, if it be required to determine the space to be left between the outside of a cylindrical pot, boiler, or still, and the wall of the furnace, first find the area of the horizontal circular section of the vessel, measured on the outside by any of the methods in use for that purpose, (which may be seen in Mr. Nicholson's Operative Mechanic, page 694, or any treatise on Mensuration;) and to this area add that of the free space between the bars of the grate, the sum will be the area of the circle to be formed by the internal side of the wall; the diameter of which being found, the difference between this diameter and that of the vessel being halved, will be the breadth of the space to be left between the vessel and the wall of the furnace.

In these kinds of furnaces there is seldom any contraction or throat between the fire-room and the chamber in which the vessel hangs. Curaudau has proposed to throw an arch over the fire-room, with a circular opening in the centre, and affirms that by thus contracting the space to which the full force of the fire is first applied to the vessel, it produces a more powerful effect; but there also arises this inconvenience, that this part of the vessel is liable to be burnt out before the other parts, so that frequent renewals of the vessel are requisite. When, indeed, the vessel is very large, it requires to have its bottom supported by pillars of masonry, so disposed as to allow a free passage for the air that has passed through the fire to get to the vent.

Furnaces with chambers over the fire-room are also used by tobacco pipe makers, and in the potteries. In these furnaces the roof of the fire-room is pierced with several holes, that the heat may be distributed as equally as possible through all the parts of the chamber.

In the furnaces used for roasting ore, and smelting them, as also in certain other operations, as in baking porcelain ware, the chamber is placed on one side of the fire-room. The communication in these furnaces is usually made by a single opening, but sometimes a series of holes are used. The larger furnaces used by the potters have a large central chamber, with four or six fire-rooms surrounding it, and opening into it by as many single openings. The metallurgists also sometimes use a central chamber with a fire-room at each end.

Many contrivances have been adopted for the purpose of introducing a supply of fresh air into the chambers of furnaces, to consume the smoke which is emitted in such quantities every time the fire is supplied with raw pit coal. A direct entrance into the chamber has the disadvantage of cooling it considerably, and is therefore not adviseable in any circumstances, and in addition to this the smoke itself is not thoroughly consumed by this method.

Several patentees have made channels in the masonry of the furnace leading from the top of the ash-pit, near the grate, into the chamber; and some have furnished these channels with sliders. Others have made channels in the walls of the fire-room, opening at one end to the external air, and at the other into the chamber. The object of these patentees being to supply the fresh air in a heated state, that it may accend the smoke, and thus cause its consumption; but as the furnace is always considerably cooled every time the door is opened to supply coal, the smoke is sometime before it will burn.

A still more powerful method of effecting this object has been lately proposed by Mr. Chapman, of Whitby. He causes the bars of the grate to be cast hollow, and when set in the furnace they open into two boxes, one placed in front, and the other behind the grate. In the front box, which is, of course, directly under

the stoking door, he has a register to admit more or less air at pleasure. The box behind the grate opens into an empty space, which is formed by making the bridge of the furnace double. Hence, when the register of the front box is open, there is a great draught of air through it, along the interior of the grate bars, thence into the space between the two walls of the bridge, and out of the slit at the top, where it comes in contact with the smoke, and as soon as the cooling of the furnace, by the opening of the door, is overcome, causes it to inflame and become a sheet of bright fire under the bottom of the boiler; but when a close hopper is used, and the introduction of cold air prevented, the smoke is entirely consumed from the first.

Opening into the Chamber.—An opening into the chamber is required in almost every case. This is very commonly at the top, being a circular hole in which the pot or still is hung. Sometimes it is on the side, as in those called English reverberating furnaces, used for roasting and smelting ores, or in potters' kilns.

It is seldom that these openings into the chambers have doors adapted to them, as they are closed either by the vessel, as in the first case just mentioned, or they are filled up at the commencement of each operation by means of slight brickwork, which is moved when the operation is performed.

Sometimes the opening into the chamber is left open, and actually serves in some cases as a vent, the usual vent being stopped.

The Vent.—The vent of the furnace has given rise to much difference of opinion as to the size it ought to have. Some make it large, to allow a free passage for the burnt air in the chimney; others again small, that the heat may not be dissipated and carried up into the chimney in waste.

It is generally a single opening, but in porcelain furnaces the manufacturers use a number of small openings instead of a single vent, with the view of assisting in the equal distribution of the heat throughout all parts of the chamber: and this practice should be adopted whenever this equal distribution is requisite. These artists are also careful that the sum of the areas of these holes should be exactly equal to that of the throats by which the flame and heated air enters into the chamber. It seems, therefore, adviseable in all cases, to make the vent or vents equal in area to that of the free space left between the bars of the grate.

The situation of the vent is usually at the top or back of the furnace; but there results a very great inconvenience from its being situated in the latter position; since, when the feeding or stoking doors are opened to supply fresh fuel, or manage the fire, a strong indraught of cold air takes place, which rushes over the surface of the fire, and not only cools the whole interior of the furnace, and prevents the accension of the vapor from the raw fuel, thus causing the production of smoke and soot, but also cools the vessels and materials exposed to the action of the fire; and when the vessels are made of glass, pottery ware, or cast iron, frequently cracks them, unless they are defended by a thick coating of lute, which necessarily diminishes the heat that can be applied to the materials contained within them.

Mr. Losh, already mentioned as a considerable improver of the construction of furnaces, has therefore proposed to remove the vent to the front of the furnace, immediately over the feeding or stoking door, and to conduct the burned air through channels made in the masonry, into the flue of the chimney. A great advantage attends this construction, that when either of the entrances into the fire-room are opened, the indraught of air, instead of rushing over the surface of the burning fuel, and striking against the vessels and materials, instantly passes up the vent, and does not enter at all into the interior of the furnace, whence this is much less cooler than in the furnaces of the usual construction.

As the entrance of air into the furnace is regulated by sliders and other contrivances, so, in many furnaces where this is neglected, its outlet is regulated by a damper or slider placed at the vent, by which its opening into the flue is altered at pleasure, and may be even stopped entirely: but it is far preferable always to have a door to the ash-room, or entrance for the air, and regulate the fire by it.

The Chimney or Flue.—The chimney

or flue is one of the most important parts of a furnace, and yet, in general, the least attended to, being usually made much too large in its horizontal area. By making it thus large, the draught through it is much diminished, and the soot collects and becomes troublesome; for when the sides of the flue contain a larger surface than can be duly heated, the necessary rarefaction of the air passing through it is destroyed. On this principle, alone, the draught of chimneys depends; and the cavity being too large proportionably to the current of air, the force of it is so diminished that the soot, instead of being blown out, gathers and rests on the sides till it obstructs the passage, and choking up the draught deadens the fire; especially at the first lighting of it, by which means the progress of the operation is sometimes greatly retarded. Instead, therefore, of the large proportion now made use of, if the chimney be intended for the use of one furnace only, an area equal to that of the free space between the bars of the grate is fully sufficient; and this may be increased in proportion where it is designed for a greater number.

The Reverend Mr. T. Ridge has observed, that if a recess is left at the bottom of the flue, below where the vent of the fire-place enters it, the soot collects in this recess, and the fouling of the flue is proportionally prevented.

This recess or well might have an opening made into its lower part, which, being opened occasionally, the soot might be extracted without the necessity of ascending the flue.

It is well known, that when flues are carried horizontally, for the purpose of connecting a furnace with the upright shaft of a chimney, they fill very fast with soot, the draught through them can scarcely be maintained, and they are even apt to burst. On adding a recess on this principle to a horizontal flue, all the soot collected in the recess, and the flue was scarcely soiled. A single flue is sometimes made to serve for several furnaces, which is advantageous when a number of furnaces are in constant action, so as to keep the mass of the chimney at a sufficient heat, that the ascensional force of the air which has passed through the fire, is not diminished by cooling. But unless this condition can be maintained, separate flues for each furnace will be most advantageous.

All the furnaces attached to a single flue, which are not in use, must be kept close shut up, or, at least, the dampers at their vents, if they have this apparatus, closed, otherwise a false draught will take place, and the cold air passing through them will cool the flue, and diminish the heat of the furnaces that are in action.

The stability of the chimney against the action of the wind, when it stands separate from other buildings, requires that it should have a sufficient breadth of base. The calculations of Mr. Tredgold, in the supplement to the Encyclopædia Britannica, show that each side of a chimney, having a square basis, or the narrowest side if the basis be rectangular, should be at the least cne foot in breadth for every ten feet in height; and the area of the flue ought not to exceed one third of the area of the chimney.

The chimneys of our common domestic fire-places have their upper terminations enlarged by the addition of a circular chimney-pot, which circumscribes their square flue. This enlargement is vulgarly, but erroneously, called a contraction, by those who look only to the external appearance, without considering the greater thickness of the brick-work in respect to the sides of the pot; and is supposed to increase the draught of the flue.

With the same view, the chimneys in Venice are terminated by pots which are of a conical form, much wider at top than at bottom. From the experiments of Venturi on the flowing of fluids through pipes, it would appear that this construction was preferable to our own chimney-pots, which are, on the contrary, rather narrower at top than at bottom. In describing the fourneau lithogeognosique of Dr. Macquer, an occasion will be had to relate an experiment of M. Guyton de Morveau, relating to adding a conical flue widening at top to this furnace.

When the chimney has attached to it furnaces which give a great heat, and of course have a strong draught, the ascensional force of the heated air will overcome the action of the wind, unless it blows a perfect storm. But in chimneys attached to furnaces of no powerful ac-

tion, the wind frequently prevents the exit of the burned air, and thus diminishes the power of the fire. Hence all chimneys should have the top of their side walls sloped upwards from the outer surface to the inner, in order that the wind impinging on the top may be deflected upwards, and thus assist in drawing out the smoke and burned air.

The wall of chimneys is usually single, but when the air which passes up the flue is very hot, it has been found preferable to have the wall double, with an empty space left between the two, which are tied together from space to space by bricks passing from one to the other.

Velocity of the Draught.—It might be supposed that the velocity of the draught through furnaces would long ere this have been reduced to calculation. Yet this is not the case, and the various measures of it by the several mathematicians who have investigated the subject, differ in an astonishing degree. They all, indeed, proceed upon the principle of the acceleration of velocity in falling bodies, and the usual theorems of hydrodynamics, but vary very considerably in the application of them.

The mathematical investigation of this apparently simple question may be divided into two classes. Most of them found their calculation on the compound ratio of the acceleration produced by the height of the chimney, and of difference in specific gravity between the external air of the atmosphere, and that in the flue of the chimney; and yet even these do not agree in the results they obtain. On the other hand, Mr. Davis Gilbert, whose fame as a mathematician of the first rank is unimpeached, stands alone, as he grounds his calculation on the velocity with which atmospheric air rushes into a vacuum, or any medium of less density than itself.

They equally differ as to the place where the temperature of the heated air shall be taken to compare with that of the atmosphere: as the generality of writers take the temperature from the top of the chimney, where the heated air rushes out into the atmosphere: while Mr. Davis Gilbert in this point varies from his brethren in choosing the temperature of the hottest part of the furnace for the groundwork of his calculation.

Taking then, as an example, a furnace adapted for melting copper, with a chimney forty feet higher than the half or average height of the entrance for air, the temperature of the hottest part of which is 1500 degrees of Fahrenheit, and that of the air issuing from the chimney 123 degrees of Fahrenheit, and that of the external air 40 degrees of the same scale. If we calculate the velocity according to the principles of M. Montgolfier, who is the first author who investigated the subject as they are laid down by M. Payen in the Dictionnaire Technologique, namely, that the draught is equal to the velocity that would be acquired by a heavy body in falling through a space equal to the simple difference of the height of two similar columns of air standing upon the same base, the one of the air of the external atmosphere, and the other column of the air in the chimney, of the same height when hot, but reduced by cooling to the temperature of the atmosphere. Now, according to this hypothesis, the heated air will pass out of the chimney with a velocity of 10 feet .19 in each second of time.

Another mode of calculation has been given in the article "Furnaces," in Rees' Cyclopædia, grounded upon Mr. Atwood's theorem, which leads the writer of that article to divide the difference of the specific gravity of the heated air and external air by their sum, the quotient multiplied by the velocity which a falling body would acquire, by falling freely through the height of the chimney, will, it is said, give the velocity of the current of air through the flue. But this velocity will, the writer thinks, be double the real velocity, on account of the retardation which the current experiences by the friction against the sides of the flue. Now, if this mode of calculation be pursued, the velocity of the air issuing from a furnace of this kind will be 3 feet .88 in a second of time; so that if the half of this calculated velocity be taken for the real velocity, it will be 1 foot .94.

Passing over for the present the calculations of Mr. Davis Gilbert, as being founded upon a totally different hypothesis, the next author who has considered the subject is Mr. Sylvester, in the Annals of Philosophy, for June, 1822. He refers to Mr. Davis Gilbert's calculations, and conceives that the hypothesis on

which he proceeds must be erroneous, because it produces for its result a velocity which far exceeds that of heavy bodies falling freely in a vacuum, whereas the resistance of the medium must produce some retardation of this velocity.

According to Mr. Sylvester, the velocity of the current of heated air will be equal to the difference between the specific gravity of the cold external and heated internal air, divided by the specific gravity of the cold external air, and the quotient multiplied into the acceleration of velocity that would be acquired by a body falling the height of the chimney. Whence, on the preceding data, the velocity would be 7 feet .74.

In a recent work written by Mr. Tredgold, he has given very elaborate formulæ for calculating the draught of ventilating pipes, and the chimneys of furnaces. He assumes the force whereby the current ascends, to be equal to the height of the chimney, multiplied by the expansion the air suffers from the increased temperature to which it is subjected, and that the velocity is equal to the square root of sixty-four times the force, from which velocity three-eighths, or even one half, must be deducted on account of contractions, eddies, bends, and friction.

Now, on this hypothesis, the theoretical velocity of the current of air in the flue of a furnace of this kind will be equal to 18 feet .9; from whence, deducting one half, the actual velocity is probably nine feet and a half.

Hence, although these mathematicians all proceed upon nearly the same theory, still great discrepancies exist in their results. According to Montgolfier's calculations, the velocity of the draught in every second of time is 13 ft. .91; the writer in Rees' Cyclopædia, 1 ft. .94; Mr. Sylvester, 7 ft. .73; Mr. Tredgold, 9 ft. .50.

But these differences vanish entirely before the calculation of Mr. Davis Gilbert, in the Quarterly Journal of Science, for April, 1822. According to this gentleman, the rarefaction or expansion of the air by the heat being ascertained, by raising the fraction $\frac{481}{480}$ to the power whose index expresses the difference of temperature, and the density or specific gravity of the burned air, as compared with that of the external atmosphere, which Mr. Gilbert states at 1.0874 to 1, the expansion divided by the specific gravity of the burned air will show the specific gravity of the air within the chimney.

The tendency to ascend will, he says, be equal to the difference between this specific gravity and that of the atmosphere multiplied by the quotient obtained by dividing the height of the chimney by the height the atmosphere would have if it were of uniform density throughout, which is assumed by Mr. Gilbert to be 26058 feet. The square root of this product is to be multiplied by the velocity with which the atmosphere would rush into a vacuum, namely, 1295 feet in a second of time; and the product divided by the square root of the specific gravity of the lighter air will give the velocity.

Now, according to this hypothesis, the velocity of the air passing through the above mentioned furnace would be no less than 225 ft. .67 in a second of time, which, being equivalent to 153 miles in an hour, is about five times the velocity of the wind in a full storm.

It would appear from the immense discrepancy between these calculations of the velocity by the most eminent mathematicians, that every attempt to reduce the question to mathematical calculation, has hitherto proved utterly abortive, and has left the subject in as much obscurity as ever. Thus much seems certain, that if any smoking or fuming body be held near the entrance of the air into a very powerful melting furnace, when in full heat, the velocity with which the smoke or fume is drawn into the furnace seems by no means so rapid as might be expected on the calculation of Mr. Davis Gilbert. Mr. Haycroft observes, that the heat in blast furnaces does not increase merely in the ratio of the fuel consumed, but in some compound ratio; and that even in air furnaces, those through which the greatest quantity of air passes in a given time, consume a proportionably less quantity of fuel to produce the same effect.

Annoyance of Smoke.—It has been already seen how many contrivances have been had recourse to for preventing the annoyance of the smoke, so plentifully emitted by raw pit coal, when suddenly heated, without the contact of a sufficient

quantity of heated air; and to this nuisance there are frequently superadded those of arsenical and sulphureous vapors, volatilized metals, and other matters, which spread widely around the works wherein they carry on the smelting of metals.

In the German mineral works, a long and large horizontal flue is interposed between the vent and the ascending flue of the chimney, in which the arsenical vapors are condensed and collected for sale; but this is not always practicable, nor would it be always sufficient.

Mr. Jeffreys, of Bristol, has proposed a plan for avoiding this nuisance of arsenical fumes, and which may also be employed to condense and collect the smoke. His plan is to build two flues, either contiguous, or at any distance from one another, but connected at top by a horizontal flue. The second flue is covered with a cistern, whose bottom is pierced with a number of small holes, like a common cullender; and this second flue has at the bottom an opening on the side to let out the water that runs down it.

Now, when the furnace is used, water is let on to the cistern at the top of the descending flue, which immediately runs in small streams through the holes in the bottom, which divide into drops as they fall, and carry down air with them, produce a considerable draught through the flues, differing from the draught produced by bellows, or ordinary blowing machines, by being applied behind the fire, and drawing instead of pushing the air through it.

This shower of water, as soon as it intermingles with the smoke and vapor of the fire, also immediately condenses and mingles with them, carrying them down, so that they run off with it through the opening at the bottom of the flue.

The efficacy of this mode has been completely established by experiment. The draught of air through the furnace was prodigiously increased; and although the ascending column of smoke was rendered as dense and black as it could well be made, yet not a particle of smut or smoke was observed to escape by the vent at the bottom of the water flue. A strong current of air and a stream of black water issued forth, but nothing like smoke.

Though advantage may be derived in various ways from the application of this invention, and more especially where the expense of carrying it into effect bears but a small proportion to the advantages that will accrue, still, it may be expected, that many instances will be found in which the difficulty or expense of procuring the necessary supply of water, and possibly other causes, will operate as a total bar to its adoption. On the other hand, it is not improbable that time and reflection may discover remedies which at the outset may not occur; thus, when the furnace is used to heat a steam boiler, a part of the power may be expended in raising water for this purpose.

Conical Dome.—In some chemical works the laboratory itself is the real chimney of the furnace, and is used to produce the necessary draught, as in glass-houses and potteries. In these manufactories a large conical dome surrounds the furnace at some distance, so as to allow the workmen free access to it. This dome is carried to a considerable height, and surmounted at top by a short cylinder. The air then being admitted into the furnace from a vault under ground, passes through the fire, and out of the fire-room or chamber into the dome by several openings above the level of the workmen's heads; and as no more air is admitted into the dome by the doors than is absolutely necessary for the respiration of the workmen, the fire receives nearly the full benefit of the velocity of draught produced by the height of the dome.

Chemists have sometimes endeavored to imitate this construction in their small experimental laboratories, when they had only a wide recess with a single flue, like those formerly used in English kitchens, and still in farm-houses, for their chimney. To obtain a great degree of heat in their wind furnace, although its proper chimney rose only two or three feet high, they fitted a pipe of three or four inches diameter to the ash-room of their furnace, and passed the other end through the wall of the laboratory; this end was sometimes widened into a kind of funnel.

As mere practical chemists have seldom much knowledge of hydrostatic and pneumatic theories, many have complained that they did not receive the be-

nefit they expected from this air pipe. This was because they neglected the necessary conditions for its proper action; which are, first, that the ash-room door be closely stopped, so that no air may pass the fire but what comes through the pipe; secondly, that the windows and doors of the laboratory be accurately closed, and even paper pasted over the crevices to prevent any entrance of air through them to create a false draught up the chimney; and lastly, that the door be not opened during the process, unless the operator be much distressed in his respiration, and then only for a moment. By these precautions being taken, the laboratory becomes a part of the chimney, and the full effect of its height is produced.

Blast of Air.—The introduction of a blast of air into furnaces, instead of depending upon their own draught, is used when it is not convenient to construct a chimney of sufficient height to produce the intended effect, or when it is desired to obtain this effect in a shorter space of time than would be required in air furnaces, as these last take a considerable time before they attain their full draught, by the mass of masonry of which they consist carrying off a considerable portion of the heat, until it becomes so well heated as to require no farther addition, except to supply that portion which passes through the walls themselves.

Two methods have been employed to produce this artificial blast. The oldest is probably the water blast, or that produced by the air, which is carried down by a shower of water made to fall a sufficient height. As this fall could not always be obtained where a blast was wanted, recourse was had to bellows of various construction, and blowing machines.

On both these methods the blast, as originally produced, is more or less unequal, and requires regulation. Three methods are used for this purpose: in the one, the blast, as it issues from the machines, is introduced into a chamber of very great size, either constructed of iron plates, or masonry, or cut in the substance of a rock, by which means the unequal blast of the machines is equalised, and it issues out at the other end in a regular stream.

In the second method, the blast is thrown into a vessel with a moveable top, sliding up and down in it at pleasure, it being kept horizontal by an iron standard or rod rising from its centre and passing through a hole in a cross-piece fixed above the vessel. This sliding moveable top is loaded with as much weight as is judged necessary. The blast, then, being sent into this regulator, as it is called, raises the moveable top, and the weight placed on it regulates the strength of the blast.

In a third method, the blast is first thrown into a large vessel of wood or iron plates, opened at bottom, closed at top, and fixed in a large cistern of water. Here the water being driven out by the blast, rises in the cistern, and by its pressure regulates the blast to the furnace.

Provision to be made.—Previous to *building furnaces*, it is necessary to provide the iron work necessary in their construction, that no delay may take place.

An iron door with its frame, for the lighting of the fire, and taking out the *scoria* of the coals, is requisite for most kinds of them; but as such doors are commonly intended for the farther use of feeding the fire with fuel, they are made much larger than is necessary. If that method be not used, it is yet proper always to have them as long as the fireplace, or area made by the bars. They need not, however, for ordinary furnaces, be more than four inches high, where they are not designed to serve for feeding the fire. For the lower they are, the less they will be capable of injuring the proper draught of air through the fuel, by making a false one, and the less liable also they will be themselves to warp, and be out of order. They should be made of hammered iron, lined with a plate of cast iron well rivetted to the other. The usual form will very well serve, if the latch to keep them shut be made bigger than common, and carried across the whole door, to give it strength to resist the weight of the fuel, which otherwise, when the iron is softened by violent heat, forces the middle part outwards.

A proper cast iron frame is necessary to be provided for the hole through which the fire is to be fed with fuel, when that method of doing it is followed. The frame must be made of the size and form of the hole, which, in middling-sized

furnaces, may be four inches wide, and three high, or bigger where the furnace is large. The bottom plate should project six or eight inches beyond its joining with the side plates, and be four or six inches wider, in order to form a slab on which the stopper or stopping coal may be laid. This stopper is usually a brick, which does full as well as any other thing. The frame itself may be merely a slab of cast iron, about a foot square, or even a tile of that dimension, and the top and sides formed of wrought iron bars, bent into the proper form.

Plates and broad bars are also generally wanted, to be laid where brick-work is to be raised over the hollow parts of furnaces. Where larger plates are required, the cheapest and best way is to have them cast of the exact dimensions wanted. But, when a broad bar or two, laid together, will answer the end, the easiest way is to have them cut off of a proper length, from the bars of hammered iron at the ironmongers. The right proportion of them may be easily computed, by estimating the proportion of the parts of the furnace they are to be subservient to, which should be always carefully done, and the workmen should be apprised, by written instructions, and drawings, of the size and measure of every thing they are to erect or put together.

In chemical manufactories, the proprietors should contrive to continue their processes night and day, or if that is not practicable, they should stop all the openings in the furnace so close as to prevent the furnace from cooling during the night. Furnaces thus kept constantly hot will last six or seven times as long as those will do which stand frequently idle. The contraction of the materials during the time of cooling, alternating with their expansion when they are again put into use, wear them out very rapidly.

When this continual use of the furnaces cannot be adopted, some chemists, in order to make them last longer, bind them with iron bars, either screwed together, or fastened by loops and wedges; others, taking advantage of the cheapness of cast iron in England, enclose them in cases of that metal, cast for the purpose, with proper openings, the several parts of which case are screwed or pinned together.

For common furnaces, thin flat bars of tough iron, about eight inches longer than that part of the furnace where they are to be inserted, slit for four inches at each extremity, and the ends turned up, are built in each alternate course round the fire-room and chamber, by which means the expansion of the furnace is attempted to be checked, and its retraction secured.

The usual method of bricklayers building in pieces of small hoop iron between the courses of brick, is a ridiculous absurdity. Nor should a chemist allow them to plaster over his furnace, or surround their edges with cloth, or sheets of lead. If there be fear of the edges getting chipped by pails, or other vessels, let them be surrounded with an iron hoop, or if this should be prejudicial to the materials which may be at times dragged over them, then the edges may be made of a wooden curb, fastened together with tree-nails.

Experiments on the Transverse Strength and other Properties of Malleable Iron, with Reference to its Uses for Railway Bars. By Peter Barlow, F. R. S., Cor. Mem. Inst. of France; of the Imp. and Roy. Acad. of Petersburgh and Brussels, etc.

[Continued from page 68.]

This want of stiffness is, I should imagine, but badly compensated by the trifling saving of metal thus effected; for I find that an addition of little more than four pounds per yard, would convert this rail into a rectangular one of the same depth, which would have one-third more stiffness at its middle point, and probably one-half more a little beyond the middle of the half-lengths. I am aware, objections are made to rectangular bars having so much depth of bearing in their chairs, and this may be a practical defect, on which I shall offer no opinion; at all events, it is well to estimate properly both evils, and then to choose the least.*

Having thus satisfied myself on the nature of the fish-bellied rail, I proceeded with my experimental inquiries, which I have divided into the following sections:

1. To determine the extension of an iron bar of given area, under different degrees of tension; and hence the force with which

* It will be seen in a subsequent page, that by introducing what is called a lower web, that, weight for weight, a parallel rail may be made as strong as the fish-bellied, with only an additional depth in the chair of three-quarters of an inch.

the same bar will contract with a given reduction of temperature.

2. The comparative resistance of malleable iron to extension and compression, and thereby the position of the neutral axis.

3. The figure of the area of section, which gives the greatest strength with the same quantity of metal.

4. The strains which bars of given sections are capable of sustaining without injury to their elastic power.

Experiments to determine the quantity which iron extends under different degrees of tension.

Fig. 1.

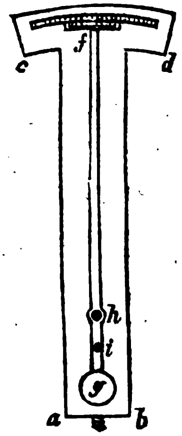


Fig. 2.

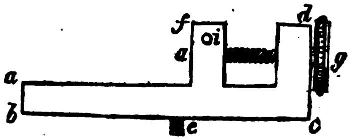
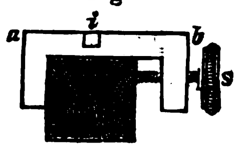
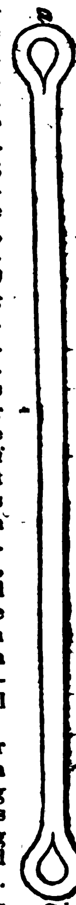


Fig. 3.



With a view to this inquiry, an instrument was made as in the annexed sketch, fig. 1. *a b c d* is a piece of brass, about one-fifth of an inch thick, having an arc at top, divided into tenths of inches; *h f g* is a hand, with a vernier, turning freely on a centre *h*; and *i* is a steel pin, about half an inch long, projecting perpendicularly forward; the distances *f h* to *h i* being as 10 to 1. *e* is a small end with a screw, for the purpose described below. *a b c d*, fig. 2, is another piece of brass, having a screw *e*; *f* is a piece working in a dove-tail, adjustable for position by the screw *g*, and *i* is another steel pin projecting forward. *a b*, fig. 3, is an iron saddle-piece, with a set screw *s*; and at *i* a hole is tapped to receive the screw *e*, fig. 2; and another saddle piece, exactly like this, is made to receive the screw *e*, of fig. 1.



The iron bars intended to be experimented on were made of the annexed form, about ten feet in length; these, by proper bolts and sheckles, were fixed at *a* and *b* in the proving machine;* the two saddle pieces were then fixed on at the exact distance of 100 inches; the instruments, fig. 1 and 2, screwed into their respective saddle pieces, and a light deal rod hung, by means of two small holes formed in it, (also at the distance of 100 inches,) upon the two pins *i i*; and then by means of the set-screw, fig. 2, the vernier of fig. 1 was adjusted exactly to zero. The pump of the hydraulic press was now put in action, and after one, two, or more tons pressure were on, according to the size of the bar, and every thing brought well to its bearing, the hand was again adjusted to zero, after which the index was read for every additional ton. Here it will be seen, that whatever the bar stretched between the two instruments, the lower pin of fig. 1 was drawn forward, and the index-end thrown back ten times that amount, consequently to ten times the actual amount of the quantity stretched.

It has been observed, that after one, two, or more tons strain were applied to bring every thing well to its bearing, the index was adjusted to zero, and its reading afterwards carefully registered as each additional ton was added. The strain during the experiment was repeatedly let off, and the index was found to return to zero, till the strain amounted to about nine or ten tons per inch, when the stretching became greater for each ton, and the bar did not

* The Lords Commissioners of the Admiralty having been pleased to allow me any facilities His Majesty's Dock-yard at Woolwich afforded for conducting these experiments on a proper scale, the proving machine here referred to is an hydrostatic press, constructed by Messrs. Bramah's, principally for the purpose of testing or proving the iron cables, before they are issued for service. It is an excellent machine of its kind, is capable of bearing a strain of 100 tons, and is very sensible to a difference of strain of 1-8th of a ton.

any longer regain its original length when the strain was removed, its elasticity with this tension being obviously injured.

These experiments required more attendance than it was possible for one person to give; the adjustment of the weights, the reading and registering the index, required each the undivided attention of one individual; the pumping also required to be watched with care. And I have great pleasure in acknowledging the ready assistance I received from Messrs. Lloyd and Kingston, the Engineers of the yard; from Mr. P. W. Barlow, Civil Engineer; as also from Lieutenant Lecount, who came from Birmingham to witness and assist in the experiment.

Experiments on the Longitudinal Extension of Malleable Iron Bars, under different Degrees of direct Tension.

TABLE I.

Feb. 21—Bar No. 1, 1 inch square.

Weight in tons.	Index Readings.	Parts of the whole Bar extended by each ton.
2	zero	
3	·0625	·0000625
4	·156	·0000935
5	·265	·0001090
6	·375	.0001100
7	not observed	mean.
8	·562	·0000935
9	not observed	mean.
10	·750	·0000940
11	·875	·0001250

Bar No. 2, 1 inch square.

2	zero	
3½	·11	·0000733
4	·15	·0000800
5	·24	·0000900
6	·35	·0001100
7	·44	·0000900
8	·52	·0000800
9	·62	·0001000
10	·70	·0000800
11	·81	·0001100
12	1·13	Elasticity injured.

Feb. 23—Bar No. 3, 1 inch diameter.

1	zero	
2	·16	·0001600
3	·31	·0001500
4	·44	·0001300
5	·56	·0001200
6	·67	·0001100
7	·79	·0001200
8	·91	·0001200
9	·103	·0001200

Bar No. 4, 1 inch diameter.

Weight in tons.	Index Readings.	Parts of the whole Bar extended by each ton.
1	zero	
2	·15	·0001500
2	·28	·0001300
4	·42	·0001400
5	·56	·0001400
6	·69	·0001300
8	·79	·0001000
7	·97	·0000800
9	·116	Elasticity destroyed

Mean extension per ton, per square inch,
Bar No. 1. ·0000982
No. 2. ·0000903
No. 3. ·0001010
No. 4. ·0000976

Mean of the four . . . . ·0000967

TABLE II.

Feb. 28—Bar No. 5, 2 inches square.

Weight in tons.	Index Readings.	Parts of the whole bar extended by each 4 tons.
4	zero	
6	·100	
8	·180	·000180
10	·240	·000140
12	·290	·000110
14	·350	·000110
16	·400	·000110
18	·450	·000110
20	·500	·000100
22	·550	·000100
24	·600	·000100
26	·650	·000100
28	·695	·000095
30	·740	·000090
32	·790	·000095
34	·825	·000085
36	·860	·000075
38	·920	·000095
40	1·05	·000145 Elasticity exceeded.

Bar No. 6, 2 inches square.

4	zero	
6	·090	
8	·150	·000150
10	·210	·000120
12	·250	·000100
14	·290	·000080
16	·335	·000085
18	·375	·000080
20	·410	·000075
22	·445	·000070
24	·485	·000075

Weight in tons.	Index Readings.	Parts of the whole bar extended by each 4 tons.
26	·525	·000080
28	·565	·000080
30	·620	·000095
32	·660	·000095
34	·730	·000110
36		Full elasticity.
38		
40		

March 7—Bar No. 7, 2 inches square.

4	zero	
6	·065	
8	·125	·000125
10	·175	·000110
12	·230	·000050
14	·280	·000050
16	·335	·000050
18	·385	·000105
20	·435	·000100
22	·480	·000095
24	·530	·000095
26	·575	·000095
28	·625	·000095
30	·670	·000095
32	·715	·000090
34	·755	·000085
36	·805	·000090
38	·850	·000095
40	·900	·000095
		Elasticity perfect.

Mean extension per ton, per square inch,

No. 5.	·0001082
No. 6.	·0000957
No. 7.	·0000841
Mean	·0000946
Mean of preceding Table	·0000967

Collecting the results of these seven experiments, and reducing them all to square inches, we find that the strain which was just sufficient to balance the elasticity of the iron, was in—

Bar, No. 1.	(re-manufactured iron)	10	tons.
" 2.	ditto	11	"
" 3.	new bolt	11	"
" 4.	ditto	10	"
" 5.	(re-manufactured)	9.5	"
" 6.	ditto, from old furnace-bars,	8.25	"
" 7.	new bar, by Messrs. Gordon,	10	"

We may consider, therefore, that the elastic power of good iron is equal to about ten tons per inch, and that this force varies from ten to eight tons in indifferent and bad iron. It appears, also, (considering ·000096 as representing in round numbers $\frac{1}{10000}$th,) that a bar of iron is extended one ten-thousandth part of its length by every ton of direct strain per square inch of its section; and consequently, that its elasticity will be fully excited when stretched to the amount of one-thousandth part of its length.

Remarks on the foregoing Experiments.

These results have an important bearing on the question of railway bars. We shall see, in the following section, how they become applicable to the investigation of the transverse strain; but, at present, I shall only speak of them as they apply to the fixing of the rail to the chair. Amongst the numerous models which the Directors did Messrs. Rastrick, Wood, and myself, the honor to submit to our inspection, for the purpose of awarding their prize, there were several in which it was intended to fix the rail permanently to the chair—a very desirable object, if it could have been safely adopted; and it was the want of data to enable us to decide on this point, which first led me to propose this course of experiments. The question is now satisfactorily answered. We have seen that, with about ten tons per inch, a bar of iron is stretched $\frac{1}{1000}$th part of its length, and its elasticity wholly excited or surpassed. Again, admitting 76° to be the extreme range of the thermometer in this country between summer and winter, it appears, from the very accurate experiments of Professor Daniell,* that a bar of malleable iron will contract with this change $\frac{1}{2000}$th part of its length. And hence it follows, that if the rails were permanently fixed to the chair in the summer, the contraction in the winter would bring a strain of five tons per inch upon the bar, and a strain of twenty-five tons upon the chair, (the bar being supposed of five-inch section,) thereby deducting from the iron more than, or full half, its strength, and submitting the chair to a strain very likely to destroy it. Every proposition, therefore, for permanently attaching the rail to the chair is wholly inadmissible.

These remarks may also be carried still further. If it be dangerous to attach the rail *directly* to the chair, it must be bad in practice to affix it *indirectly* by wedges, cotters, or otherwise, beyond what is absolutely essential to give it steadiness under the passing load; for it is evident, that if by these means we could prevent any motion taking place, we should fall into the same evil as by the permanent attachment; and if, as most probably will happen, we fail of entirely accomplishing this, still all the friction which is produced must be overcome by the contracting force of the

* See Phil. Trans. 1831.

iron, and be so much strength deducted from its natural resisting power.

The problem, therefore, which engineers have to solve, is, "To find a mode of fixing the rail to the chair, which shall give sufficient steadiness to the former; but which, at the same time, shall produce the least possible resistance to the natural expansion and construction of the bar."

The quantity of motion which thus takes place is certainly but small, viz. about $\frac{1}{11}$th of an inch between summer and winter, with a fifteen-foot bar; but the force of contraction is great, amounting to five tons per sectional inch for the annual extremes, and frequently to not less than two and a half tons between the noon and night of our summer season, while the whole power of iron within the limits of its elasticity does not exceed nine or ten tons.

This is an important consideration, and for want of attention to it, or rather, in consequence of its amount not having been ascertained, a practice of wedging or fixing the rails has prevailed, which must necessarily have been the cause of great destruction to the bars.

I would also suggest here, as a matter deserving the attention of practical men, that as the bar must necessarily contract, it will draw from that side which is least firmly fixed, and hence all the shortening will most probably be exhibited at one end, however slight the hold on either may be; and when it happens that the adjacent ends of two bars both yield, the space between the two is rendered double that which is necessary. To avoid this evil, one of the two middle chairs in each bar might be permanently attached to the rail, in which case the contraction must necessarily be made from each end, and the space occasioned by the shortening of the bars would then be uniform throughout, and much unnecessary and injurious concussion thus saved both to the rail and to the carriage.

Experiments to determine the comparative Resistance of Malleable Iron to Extension and Compression, and the position of the neutral axis in bars submitted to a transverse strain.

Let A B (see figure 1, on the following page,) represent an iron or any other bar supported at A and B, and loaded in the middle by a weight W, which deflects it; extending the fibres between n and $c\ d$, and compressing those between n and $c'\ d'$. Now, supposing the system in equilibrio, $\frac{1}{2}$ W acting at the extremity of the $\frac{1}{2}$ length, or $\frac{1}{4} l$ W, is equivalent to the sum of all the resistances to extension in $n\ c\ d$, and to all those of compression in $n\ c'\ d'$, each fibre acting on a lever equal to its distance from the neutral axis n. Consequently, as the quantity of extension of any fibre is as its distance from the neutral axis, and the lever by which it acts, being also as that distance, the actual resistance of a fibre at the distance, x, is as $\frac{x^2 t}{d'}$, t being the tension of the lower fibre, and d' its depth below the neutral axis; and the sum of all these resistances will be $\int \frac{t\, x^2 d x}{d'} = \frac{1}{3} d'^2 t$, (when $x = d'$), or for the whole depth. In the same way, c being taken to denote the compression of the upper fibre, corresponding to the tension t, the sum of all the compressions will be,

$$\frac{1}{3} d''^2 c,$$

d'' denoting the depth of compression; hence the whole sum is,

$$\frac{1}{3} d''\ c + \frac{1}{3} d'^2 t = \frac{1}{4} \mathrm{W}\, l;$$

but $d''\ c = d'\ t$,* the quantity of resistance being equal to that of extension; this, therefore, becomes

$$\frac{1}{3} d''\, d'\, t + \frac{1}{3} d^2 t = \frac{1}{4} l\, \mathrm{W}, \text{ or}$$

$$\frac{1}{3} (d'' + d')\, d'\, t = \frac{1}{4} l\, \mathrm{W}, \text{ or}$$

$$\frac{1}{3} d.\, d'\, t = \frac{1}{4} l\, \mathrm{W}.;$$

d being the whole depth, and d' the depth of tension; whence,

$$d' = \frac{3\, l\, \mathrm{W}}{4\, d\, a\, b} = \text{depth of tension, and}$$

$d - d'$ the depth of compression,

consequently, $\frac{d'}{d - d'}$ the ratio, in which the neutral axis divides the sectional area in rectangular bars.

Comparison of the Formula with Experimental Results.

In order to submit this formula to practical results, a strong iron frame was forged, of the form herewith shown (see figure 2); D C is thirty-six inches long, six inches broad, by two deep; the two arms two inches square, and the ends of proportional dimensions to those represented. The other view of the arms is represented in the side

* To prevent misapprehension, it may be proper to observe that c here is not intended to represent the force requisite to compress a fibre the same quantity that the force t extends it; but *simply*, the force of the compression at c, corresponding to the tension t on the lower fibre. The equation, therefore, $d''\ c = d'\ t$ is equivalent to saying that the sum of all the forces in $n' c' d$ is equal to all the forces in $n\ c\ d$; or that $a\ g = n\ a'\ g'$; a, a', denoting the areas, and g, g', the distances of the centres of gravity from n, and taking $n\ t$ to denote the force which will compress a fibre to the same extent as the force t will extend it.

Fig. 1.[1]

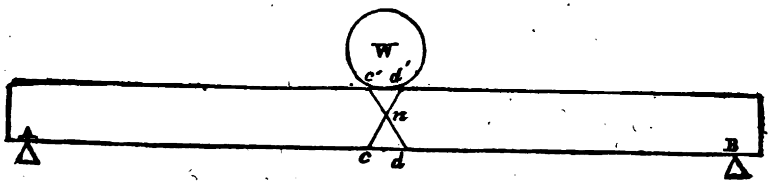
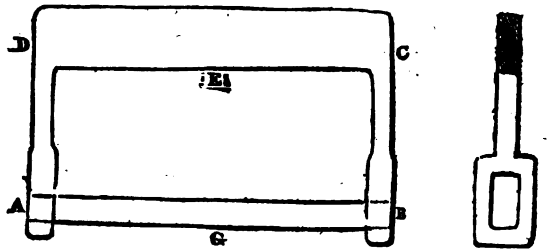


Fig. 2.



figure, with an opening six inches by three, in which the bars for experiment were placed, as represented by A G B; the space between is thirty-three inches. The shackles were applied at E and G, and connected by strong iron cables to the press; the strain was then brought on and the results recorded.

In order to measure with every requisite accuracy, the deflections which the bar sustained, as different weights were applied, an instrument of the form shown in the annexed figure was neatly and accurately

made in iron, having two feet, A D, B C; the centre was tapped to receive the brass screw, H S, of twenty threads to the inch, and the head was divided into five equal parts, and by again subdividing these divisions into ten, a deflection of $\frac{1}{1000}$ of an inch might be measured with great ease.

The method of applying it was to rest its feet on the bar, and then to retain it in its place by cramps and screws. The micrometer screw was then run down till it was in contact with the bar, and the divisions read and registered, either before any strain was on, or when the first slightest strain could be estimated, as stated in the following table.

The first six experiments were made on different parts of the bars, Nos. 5, 6, and 7, without cutting them, by introducing them into the iron frame above described (having thirty-three inches clear bearing,) and straining them till the successive deflections showed a tendency to increase in amount, which was taken as a sign of the elasticity being injured; and the amount of this strain having been previously ascertained by the former experiments, they furnish the best possible data to apply to the formula for determining the position of the neutral axis.

Experiments made to ascertain the Deflections due to different Transverse Strains, and the Weight which first produces a Strain equal to the Elastic Power, and thence the position of the Neutral Axis.

TABLE III.

PART 1. BAR No. 5.
Bearing 33 Inches. 2 Inches Square.

Weight in tons.	Readings by Scale.*	Deflections for each half ton.
No Weight.	1·96	
·875	1·92	·023
1·00	1·90	
1·50	1·90	·016
2·00	1·88	·020
2·50	1·86	·020
Weight removed.	returned to 1·96	
3·00	1·80	Elasticity injured.
Weight removed.	1·88	

PART 2. BAR No. 5.

Weight in tons.	Readings by Scale.*	Deflections for each half ton.
No Weight.	1·95	
·750	1·92	·020
1·00	1·91	·020
1·50	1·89	·020
2 00	1·86	·030

* In the first of these experiments the deflections were measured by a scale in front of the bar, the micrometer-screw not being ready.

Weight in tons.	Readings by Scale.	Deflections for each half ton.
2·50	1·84	·020
Weight removed.	returned to 1·95	
3·00	1·67	Elasticity injured.
Weight removed.	1·81	

PART 1. BAR No. 6.

No Weight.			
·50	1·56?		
1·0	1·50		
1·5	1·48	·020	
2·0	1·45	·030	
2·5	1·24	·210	Elasty. inj'd.
3·0			

PART 2. BAR No. 6.

Weight by Tons.	Readings by Micro. Screw.	Deflections for each half ton.
No Weight.	·025	
·50	·043	·018
1·0	·068	·025
1.5	·091	·023
2·0	·128	·037 injd.
2·25	·178	·100
2·50	·313	·185

PART 1. BAR No. 7.

No Weight.	·031	
·50	·053	·022
1·0	·077	·024
1·5	·096	·019
2·0	·126	·030
2·5	·147	·021
3·0	·211	·064 injd.

PART 2. BAR No. 7.

No Weight.	·025	
·50	·056	·031
1·0	·077	·021
1·5	·098	·021
2·0	·109	·011
2·5	·137	·028 injd.
3·0	·180	

PART 3. BAR No. 7.

No Weight.	·075?	
·50	·130	
1·0	·153	·023
1·5		·023
2·0	·199	·023
2·5	·220	·021
3·0	2·90	·070 injd.

PART 2. BAR No. 7—reversed.

No Weight.	·025	
·10	·054	·029
1·0	·092	·038
1·5	·153	·061
2·0	·235	·082

Elasticity clearly injured by the former experiment.

It appears from these experiments, that both parts of the Bar No. 5, (whose direct elasticity was 9·5 tons,) had their restoring power just preserved with a transverse strain of $2\frac{1}{4}$ tons on a bearing length of 33 inches. Hence in the formula,

$$d'=\frac{3\,l\,w}{4\,d\,a\,t}$$

we have $l=33$, $w=2\frac{1}{4}$, $d=2$, $a=2$, $t=9{\cdot}5$, and $d'=1{\cdot}62$ inches, depth of tension.

Consequently $d''={\cdot}38$ inches, depth of compression, and the ratio of the area of compression to tension 1 : 4·3

In the first part of Bar No. 6, w is not quite 2 tons, and $t=8{\cdot}5$ tons; and hence the ratio - - - - - 1 : 2·7

In the second part of the same bar, ditto - - - - - - - - 1 : 2·7

In the first, second, and third parts of Bar No. 7, $w=2\frac{1}{4}$ tons, and $t=10$ tons - - - - - - - 1 : 3·4

As far as these experiments are authority, therefore, the neutral axis divides the sectional area of a rectangular bar in about the ratio of one to three and a half.

TABLE IV.

Distance of bearing.	Breadth.	Depth.	Weights.	Deflections.	Deflections each ½ Ton.	REMARKS.
BAR No. 8.						
in.	in.	in.	tons.			
33	1·9	2	·125	·034		
			·250	·046		
			·500	·060		
			1·00	missed.	·019	Mean ·024
			1·50	·098	·019	
			2·00	·120	·022	
			2·25	·134	·028	w=2·25. Neutral axis 1 : 3·4
			2·50	·151	·034	
			2·75	·176	·044	Elas. inj. with 2·50 T
BAR No. 9.						
33	1·9	2	·250	·047		
			·500	·055	·016	Mean ·021
			1·00	·077	·022	
			1·50	·097	·020	
			2·00	·123	·026	
			2·25	·132	·018	w=2·25. Neutral axis 1 : 3·4
			2·50	·145	·026	
			2·75	·164	·038	Elas. injd. with 2 50
			3·00	·120	·092	Ditto dest. with 3 00
BAR No. 10.						
33	1·9	2	·500	·056		
			1·00	·076	·020	Mean ·024
			1·50	·095	·019	
			2·00	·124	·029	
			2·50	·151	·027	w=2·5. Neutral axis 1 : 4·2
			3·00			

In the above experiments, the iron was

all supplied by Messrs. Gordon, and was of the same quality as the Bar No. 7,—its elasticity may therefore be taken as ten tons, but it was not determined by testing, as in the previous experiments.

Deductions from the three last Experiments, confirmed by direct Observation of the place of the Neutral Axis.

These experiments, like the former, imply, according to the formula, that the neutral axis lies at about one-fourth or one-fifth of the depth of the bar from its upper surface; but a method was adopted in these to discover, if possible, its position mechanically. With this view, a keyway, or groove, was cut in the side of the bar one inch broad, and one-tenth of an inch deep,—thus reducing the breadth to 1·9 inches. To this keyway, or groove, was fitted a steel key, which might be moved easily; and when the strain was on, the key was introduced, which it was expected would be stopped at the point where the compression commenced, and this was accordingly found to be the case in two out of the three bars, but not in the third, the fitting not being sufficiently accurate. The other two, however, showed obviously a contraction of the groove, at about half an inch from the top, agreeing with the preceding computations. To make the results more certain, three other bars, exactly like the former, had deeper grooves cut, and the key more exactly fitted, and with these the results were as definite as could be desired. The key, as above-stated, moved smoothly and easily before the experiment; but when two tons strain were on, and the key applied, it was stopped, and stuck at a definite point. The strain being then relieved, the key fell out by its own weight; the strain was again put on, the key sticking as before; the strain being relieved, the key again fell, and so on, as often as repeated. Precisely the same happened with all the three bars. One of them was then reversed, so that the part which had been compressed was now extended, and exactly the same result followed: showing, most satisfactorily, that our former computed situation of the neutral axis was very approximate. The measurements obtained in these experiments being tension 1·6, compression ·4 giving exactly the ratio of 1 to 4 in rectangular bars. These results seem the most positive of any hitherto obtained; still, there can be little doubt this ratio varies in iron of different qualities; but looking to the preceding experiments, it is probably always between 1 to 3, and 1 to 5.

On the Stiffness of Rectangular Iron Bars, and their Deflections under different Weights.

Although it is necessary to know the actual resisting power of bars in their ultimate state of strain, in order to determine the relative strengths of differently-shaped bars, yet the question of most practical importance is the stiffness they exhibit when loaded with smaller weights; for we ought never to strain a bar so nearly to its full power of bearing, as to make this the immediate subject of inquiry.

The experiments recorded in the last section are applicable to this purpose, but as these are all of the same depth, it was thought more satisfactory to make a few other experiments on bars of different breadths and depths. They were performed precisely like the last, and therefore require no particular description.

Experiments on the Deflection of Malleable Iron Bars, under different Strains.

TABLE V.

Distance of bearing.	Breadth.	Depth.	Weights.	Deflections.	Deflections each ½ Ton.	REMARKS.
			Bar No. 11.			
in.	in.	in.	tons.			
33	1·5	3	·125	·043		
			·500	·059		
			1·00	·074	·015	Mean ·0103
			1·50	·083	·009	
			2·00	·095	·012	
			2·50	·101	·006	
			3·00	·109	·008	
			3·50	·120	·011	
			4·00	·131	·011	
			4·50	·148	·017	$w=4\frac{1}{4}$. Neutral axis 1 : 4·9 Elas. pres. at $4\frac{1}{4}$ tons.
			Bar No. 12.			
33	1·5	3	0	0		
			·50	·017		
			1·00	·037 ?		
			1·50	·052	·015	Mean ·0108
			2·00	·061	·009	
			2·50	·064	·003	
			3·00	·078	·014	
			3·50	·089	·011	
			4·00	·102	·013	
			4·50	·124	·022	$w=4\frac{1}{4}$. Neutral axis 1 : 4·9 Elasticity injured.
			Bar No. 13.			
33	1·5	2.5	0	·006		
			·50	·003	·024	Mean ·0173
			1·00	·050	·020	
			1·50	·060	·010	
			2·00	·074	·014	
			2·50	·093	·019	$w=3$. Neutral axis 1 : 4·9 Elasticity preserved, 3 tons.
			3·00	·110	·017	
			3·50	·149		
			7·5	Bent 8	inchs.	

To reduce the law of deflection from these results, we may have recourse to two well known and well established formulæ; viz.

$$\frac{l\,w}{4\,a\,d^2}=S \text{ and } \frac{l^3\,w}{a\,d^3\,\delta}=E,$$

which are both constant quantities for the same material, w being the greatest weight the bar will bear without injuring the elasticity; consequently, when l is also the same in both, $d\,\delta$ will be also constant, a being the breadth, d the depth, and δ the deflection. That is, all rectangular bars having the same bearing, length, and loaded in their centre to the full extent of their elastic power, will be so deflected, that their deflection (δ) being multiplied by their depth (d) the product will be a constant quantity, whatever may be their breadths or other dimensions, provided their lengths are the same.

Let us see how nearly our several results agree with this condition.

In the several bars, Nos. 8, 9, 10, 11, 12, 13, multiplying the mean deflection for each half ton, by the number of half tons which excited its whole elasticity, and this again by the depth of the bar, we find

	Depth.
No. 8, ultimate deflection	·108×2=·2160
No. 9 - - - - -	·094×2=·1880
No. 10 - - - - -	·120×2=·2400
No. 11 - - - - -	·0876×3=·2628
No. 12 - - - - -	·0918×3=·2754
No. 13 - - - - -	.1038×2½=·2595
	6) 1·4417
Mean - - - - - - -	·2403

There is rather a large discrepance in bar No. 9; the others are as approximative to the mean as can be expected in such cases.

If we make the same trial on the three parts of bar No. 7, we have,

1st part	·116	×	2	=	·2320
2d part	·105	×	2	=	·2100
3d part	·115	×	2	=	·2300
				3)	6720
Mean - - - -					·2240
Former Mean - - -					·2403
				2)	·4647
General Mean - - - -					·2323

We may therefore say, that any malleable iron bar, of 33 inches bearing, being strained to its full elasticity, will be so deflected, that its depth, multiplied by the deflection, due to 30 inches, will produce the decimal ·23; consequently $\frac{\cdot 23}{d}=$ the deflection, d being the whole depth in inches.

In this form, however, it applies only to rectangular bars. To make it general, we must estimate it from the neutral axis, which in rectangular bars, being ⅕th of the depth below the upper surface, the above constant, when thus referred, becomes ·2323×⅘=.1858. But, on the other hand, our instrument for measuring the deflection was but 30 inches long; it has therefore to be increased again in the ratio $30^2 : 33^2$, or as $10^2 : 11^2$ on this account; so that, ultimately, the formula is $d'\,\delta = \cdot 22$ d' denoting now the depth of the bar below the neutral axis, and in this form it is general for parallel rails of any section whatever.

A curious circumstance was observed in these experiments, which, although it has no immediate bearing on the subject in question, it may be well to notice, and which is, I apprehend, characteristic of good malleable iron, viz. that the resistance to compression, although so much greater than the resistance to extension, is the first of the two which loses its restoring power; for if we so far increased the strain as to overcome the elastic power, the point of compression descended to nearly the middle of the depth, proving that the tensile force, although so much less, is the most tenacious; whereas I suspect, that in cast iron it is the reverse, that is, it is here the tensile power which first yields, and the consequence is a sudden fracture, and momentary destruction of the bar.

On the Sectional Figure of greatest Resistance, the Area being given.

Having established the preceding data, I might now proceed directly to find, with a given sectional area, the figure of greatest resistance; but this would be of little advantage, for the form we should arrive at would be quite inapplicable to a railway, as it would require the metal to be principally collected in the lower table; whereas, in the railway bar, we must of necessity bestow a certain quantity, perhaps *two-fifths* of the whole, in forming the upper table on which the carriage runs; it is, therefore, only after this is provided for, that we are at liberty to dispose of the remaining part of the metal, and even in this distribution regard must still be had to practical convenience. Instead, therefore, of determining mathematically, the area of maximum resistance, the most useful plan will be to compute, directly, the resistance of such sectional figures as fall within the limits of practical application, and to select from them that which, under all considerations, is the best.

The three forms of rails which, under this restriction, will have to be considered, are the following:

Fig. 1.

Fig. 2.

Fig. 3.

Fig. 4.

1. The plain T shaped rail, fig. 1.

2. The H, or double T, formed rail, with a lower table, as fig. 2.

3. The Trapezoidal rail, as fig. 3. Each of which will admit of various changes of proportions, without altering the general character of the section.

The upper and the lower tables are here represented as rectangular, with sharp edges. In practice these are rounded off, the metal thus displaced furnishing a sort of bracket between the table and stem, or rib, as shown in fig. 4; but to treat of them in this form would introduce great intricacy into the calculation, without much affecting the results. It will therefore be sufficient to consider them as rectilinear.

I would here observe, also, that some projectors have made the upper and lower tables of equal figure, upon the distant contingency, that when the upper table has been worn down, the rail may be turned, and the lower table made the upper. But this is certainly providing without foresight; for the bottom table is the most efficient for strength, and it would be a very dangerous experiment, after one side of a bar has been submitted for many years to a high compressing force, and its substance (by the hypothesis) greatly worn, to turn the rail, and expose this worn part to a still greater strain, but tensile instead of compressive, which could not fail instantly to destroy it. Instead of this, therefore, I should certainly recommend to work whatever metal is introduced into the lower table or web, into that form which is most efficient for present purposes, without regard to the contingency alluded to above.

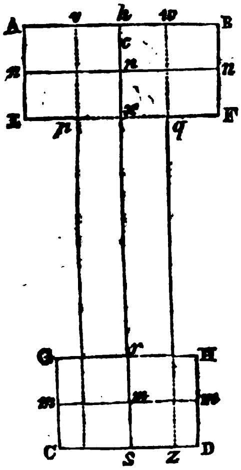
That the rail is deteriorated by exposure and wear, is undoubtedly true; although, perhaps, the amount is not yet well ascertained. Amongst the papers submitted to Messrs. Rastrick and Wood, with whom I was associated, we found it estimated at the rate of $\frac{1}{4}$th of a pound per yard per annum; but I have since seen it stated, in a letter from Mr. Dixon to Mr. Bidder, at $\frac{1}{10}$th of a pound per yard per annum. This was determined by taking up three rails, having them well cleaned and weighed, and then putting them in their places, and afterwards washing and reweighing them at the end of a twelvemonth, when two of them were found to have lost $\frac{1}{2}$ lb. in weight for the 5 yards length, and the third $\frac{3}{4}$ lb., which last was taken up from a particular situation, where it was more exposed to friction. But even this does not prove that the whole loss of weight is in the upper face of the rail; and if it did, it would be, as I have before observed, a stronger reason for not turning the rail: and, on the other hand, should the waste not be on the upper surface, the provision alluded to is unnecessary. Mr. Rastrick informs me, that even the small fins left at the meeting of the rolls are still quite distinctly seen on the face of the upper table. And Mr. Stephenson states, that the marks of the tools left in turning the flanches of the wheels are seldom obliterated; which proves, at all events, that there is no side wear.

Mr. George Bidder, who attributes all the waste to the wear on the upper surface, estimates the annual reduction at $\frac{1}{90}$th part of an inch; in which case the rails would not last more than thirty years before they would require to be replaced. And it then becomes a question, whether, in point of economy, it would not be better to lay an additional third of an inch upon the upper table, which would, by this reckoning, make the rail last sixty years. This increase of $\frac{1}{3}$d of an inch would call for an additional expense, to the amount of about $7\frac{1}{2}$ per cent. on the present cost; and this $7\frac{1}{2}$ per cent., at compound interest, would amount to about 30 per cent. in thirty years. If, therefore, a charge of 30 per cent. at the end of thirty years, would meet the amount of re-manufacture, and supply the waste, the two accounts would be about balanced. In this case, I must consider the latter as preferable. 1st. Because the other plan would increase the weight of the bar, and the difficulty of the manufacture, and probably diminish its soundness. 2d. Because thirty years' experience may introduce improvements, of which, at the end of that period, it would be desirable to take advantage. And, lastly, because I do not (judging from the opinion of different practical men) think that it has yet been

clearly determined what part of the waste is due to wear on the upper face.

To return again to the subject of the best formed section, I beg to repeat, that whatever figure the above, or other considerations, may lead practical men to adopt in the upper or lower table and rib, it will be fully sufficient for the purposes of calculation, to consider them as rectilinear, which will greatly facilitate the investigation, without sensibly affecting the results.

Comparative Strength of differently-formed Parallel Rails.



Let A B C D (above figure) represent any rectangular rail with a bottom table; $n\ n$ its natural axis; c the centre of compression, $c\ n$ being $\frac{2}{3}$ of $h\ n$. Now, the tension of each fibre being as its distace from the neutral axis, and that of the lower fibre being given equal to t, the tension at any variable distance x will be $\frac{t\,x}{d}$ (d being taken to denote the whole depth $n\ s$,) and therefore the sum of all the tensions will be,

$$\frac{t}{d}\int x.\,d\,x \qquad (1)$$

which, therefore, becomes known, x being taken within its proper limits, according to the figure of the section.

But as the effective resistance of each fibre is also as its depth below the line $n\ n$, the sum of all the resistances will be,

$$\frac{t}{d}\int x^2.\,d\,x \qquad (2)$$

x being taken here also within its proper limits. And then to find the centre of tension, or that point into which, if all the tensions were collected, the whole resistance would be the same as in the actual case, this would be given by the formula:

$$\frac{\int x^2.\,d\,x}{\int x.\,d\,x} \qquad (3)$$

which is precisely the expression for the centre of oscillation of a disc of the same figure.

We have hence the following general rule for finding the resistance or the weight which any given bar or rail will support at its middle point, within the limits of its elastic power, that is,

Calling the integral of formula (1) = A
do. do. formula (2) = B
do. do. formula (3) = D
And the distance $c\ n$ = C

then, referring the sum of all the resistances B to the common centre of compression, we have,

$$D :: D+C :: B : \frac{B\,(D+C)}{D}$$

which is the whole effect.

For those who understand the integral calculus, this solution is sufficient; but as the article will probably be consulted principally by practical men, it will be more convenient to give a specific solution for a rail, embracing under one general figure all the usual forms, the only variations being in the depth, breadth, and thickness of the parts. (See preceding figure.)

Let A B C D represent such a section, of which all the dimensions are given, as also the position of $n\ n$ the neutral axis, the point c which is the centre of compression, $c\ n$ being $\frac{2}{3}$ds of $n\ h$, and the point m which is in the centre of $r\ s$. The breadths $n\ n$ and $m\ m$ are also known. Then the resistance of the whole section referred to the common centre of compression c, may be considered to be made up of the three resistances.

1st. Of the middle rib, continued through the head and foot tables, $v\ t\ z\ w$.

2d. Of the head A E F B, minus the breadth of the centre rib.

3d. Of the lower web, G C D H, also minus the continuation of the centre rib.

Now, t being taken to represent the tension of iron per square inch, just within its limits of elasticity, we shall have,

1. Resistance of . . . $vtzw = \frac{1}{3}\,hs.\,ns.\,pq.\,t$
2. Resistance of A E F B $= \frac{1}{3}\,hx.\,nx.\,(nn - pq)\,\frac{nx}{ns}t$

Now, let $nm + \frac{rs^2}{12\,nm} = \delta'$, and $\delta' + \overline{cn} = \delta''$, then

3. Resistance of G C D H $= nm.\,rs.(mm - pq)\,\frac{\delta''}{\delta'}t$

These three resistances being computed, let their sum be called s, and the clear bearing l; then $\frac{4s}{l}=w$, the load the bar ought to sustain at its middle point, for an indefinite time, without injury to its elasticity.

[*To be continued.*]

We find in the Newark Daily Advertiser, the following account of something new in the way of propelling boats.

"Dr. PLANTOU, of Philadelphia, is now exhibiting at No. 92 Broadway, New-York, a model of his method of constructing and propelling steamboats, and will be happy to show and explain its principles to all who will do him the favor of a call. The principle is the propulsion of boats by means of water-tight revolving cylinders, furnished with paddles. One of these cylinders is placed at each end of the boat—and acting both as buoyancers and propellers, they effect, as the inventor very satisfactorily demonstrates, the important object of impelling the boat over the surface of the water without having to overcome the great resistance encountered by the usual method of forcing it through the water. The current created by the action of the forward cylinder passes entirely under the boat, and by lifting it up, aids in impelling it forward.

"Dr. Plantou's models, &c. were submitted to a select committee appointed by the last Legislature of New-York, who recommended them to the favorable consideration of the canal board. The Board have since expressed their approbation of the project."

[From the Boston Courier.]

PERNICIOUS INFLUENCES.—If there is any curse hanging like an incubus over the youth of our country, it is the spirit of *imitating* the fashionable follies of the day. Multitudes on multitudes—promising, intellectual, moral—the pride of their associates and the hope of their parents—are ruined, utterly and irretrievably, as they sink, step by step, beneath the pernicious habits and blighting examples of the thoughtless, gay, flippant, and wicked devotees of fashion and the votaries of folly—

To whose means
There's more of depth than to their brain.

From the foolish belief that they are rendering themselves objects of fashionable attraction, and winning the smiles of the patrons of the *ton*—they follow an *ignis fatuus* that inevitably bewilders them into the morasses of vice and the quagmires of debauchery. See the youth—fresh from his native bowers and verdant fields—with his rosy cheeks and athletic frame: his manners, simple, unostentatious, polite, and his habits pure as the genial air, from the blooming borders wherein he gambolled from earliest boyhood. See him—an example of health, happiness and purity. He enters the pent-up city—peeps in upon the fashionable rounds—gazes upon the numerous and bewitching amusements: and anon partakes of its indulgences and drinks of its follies. It's a new scene, and he breathes a new atmosphere. His brain is oppressed, dizzied, bewildered:

He sees—he wonders—and adores.

I had a friend—a free-hearted, chivalrous youth. He left the thatched cottage and green fields for the smoky atmosphere and clustered streets of the city. He was a youth of no common mind—kind, benevolent, upright—and would naturally draw around him those who might love him for his virtues. He was the pride of an indulgent and generous father, who soon after went down to his final rest. He left a large property for three children. Edward was soon of age and came into possession of his share. It was large and generous, and made him wealthy. With it he went in to trade, and for a little while was prosperous—wonderfully prosperous. But the demon was upon him: he neglected his business—left it to others—followed pleasure, and became a fashionable buck—behind none in the liberality of means or the prodigality of time. He went from home often—and finally closed his business and went for good. I met him in the great metropolis. But the impression made upon my mind I well remember—but cannot describe.

It was some years onward when I was again in the same metropolis. With a worthy friend I wandered abroad. We stretched down the great thoroughfare—where

All tongues and kindred meet,—

till the dusk of evening closed upon us, and we found we had dropped unwittingly into a narrow avenue, leading in an adverse direction. We wandered on—indistinctly guided by the faint glimmerings of the scattered lights; and as we turned almost an acute angle, into an intersecting lane, we stumbled over the body of a human being, stretched upon the narrow side-way on which we stood. Humanity prompted—and we took him to a neighboring dwelling. It was the bloated and unsightly figure of poor Edward, in the last agonies of death. *He had been a drunkard and a gambler.*

T. K.

ADVICE TO APPRENTICES. — 1. Having selected your profession, resolve not to abandon it; but by a life of industry and

enterprize, to *adorn* it. You will be much more likely to succeed in business you have long studied, than in that of which you know but little.

2. Select the *best* company in your power to obtain; and let your conversation be on these things you wish to learn. Frequent conversation will elicit much instruction.

3. Obtain a friend to select for you the *best* books on morality, religion, and the liberal arts, and particularly those which treat on your own profession. It is not the reading of *many* books that makes a man wise, but the reading of only those which can impart wisdom. Thoroughly underderstand what you read; take notes of all that is worth remembering, and frequently review what you have written.

4. Select for your model the *purest* and *greatest* characters; and always endeavor to imitate their virtues, and to *emulate* their greatness.

5. Serve God; attend his worship; and endeavor to set an example of piety, charity and sobriety, to all around you.

6. Love your country; respect your rulers; treat with kindness your fellow apprentices.; let your great aim be usefulness to mankind.

7. Get all you can by honest industry; spend none extravagantly; and provide largely for old age.

8. In a word, think much, act circumspectly, and live usefully.

[From the American Journal of Science and Arts.]

On Turnouts in Railroads, with Flexible Moveable Rails. By Thos. Gorton, Civil Engineer.

At a time like this, when railroads are being rapidly introduced in various parts of the United States, it is believed that any improvement relating to the various parts of their construction will be acceptable to the public.

Up to the present time all turnouts upon railroads, (so far as the writer's knowledge extends,) have been constructed with stiff moveable rails. When these stiff rails are moved round so as to make a communication with the turnout and main line, a rectilinear angle of several degrees is formed by the stiff rail and main line, which subjects cars passing through the turnout to much jar and lateral friction. This friction is so great as to injure both cars and railroad. In a late conversation with Mr. E. Miller, superintendant of machinery on the Portage railroad, he informed me that they proposed using *flexible* moveable rails for their turnouts. The rail adopted on that road is the parallel edge rail, eighteen feet long, and weighing forty pounds per yard. I understood that the plan of their turnouts was not fully matured, but that it was contemplated to have about three feet of the rail made fast in two heavy chairs, and the other fifteen feet to be sprung into a curved form, when it was desired to pass into the crossing or turnout.

This at once appeared to me to be a decided improvement, in as much as turnouts might be made on this principle, so that cars might pass through them with the same facility as in the curved parts of the main line. In examining the subject, the first requisite is, that the rail at the moveable end should be deflected so as to leave a sufficient distance between the rail of the main line and the fixed part of the turnout. Then, secondly, let the radius of curvature for the turnout be determined; it will be seen that these two requisites determine the length of the moveable rails. These rails may then be laid down in the following manner.

Let about one foot of that part connected with the main line be made fast in a heavy cast iron chair, by a wedge, and by a bolt passing through the chair and rail. The moveable part of the rail may be supported on chairs; these chairs to rest on cast iron seats, having a ledge on one side for the chairs to slide against when the rail is sprung round into the turnout. The seats consequently must be laid down in the curve form which the rail is to assume in the turnout. If it is thought that the chairs on this part of the rail will work out of place, they may be bolted to it, or secured in some other manner by guides on the seats. The two moveable rails of a turnout should then be connected by two or three stiff coupling bars, to give them permanence, and preserve the proper distance between them. The rails may then be worked by a vertical lever of a suitable length. This lever, with a ball placed upon its top, will serve as an index to persons travelling the road, by pointing out the position of the moveable rails, that the cars may be stopped in time, if the rails are not right.

The result of some calculations for rails of different lengths will now be

given, together with the length of a turnout for each kind of rail. These calculations are made for a double track of railroad, the distance between the rails of each track being 4.75 feet, and the distance between the inner rails, including the width of each rail, five feet. But as railroads in general do not differ much from this in outline, the length of a turnout will not be affected much by such difference.

The following table will be understood from the explanation given therein.

Radius of curvature in feet.	Length of movable rail not including that part in the heavy chair.	Deflection at end of rail in decimals of a foot.	Angle of crossing plates and sine of arc at each end of turnout, in feet.		Feet of straight line in the centre of turnout.	Length of turnout in feet.
310.	15 ft.	0.36	7°	37.78	40	115
350.	16	0.36	7°	42.65	35	120
400.	17	0.36	7°	48.75	30	128
410.28	17	0.35	7°	50.00	29.6	129.6
450.	18	0.36	7°	54.84	23	133
500.	19	0.36	7°	60.93	17	139
550.	20	0.36	7°	67.03	11	145

In the above table, fractions of a foot have been omitted in the last two columns, the object being to give sufficient information in a tabular form, from which a comparison of the advantages and disadvantages may be made for turnouts with moveable rails of different lengths, and arcs of different radii. An angle of 7° has been adopted in this table for the crossing plate. Increasing this angle would shorten the turnout but little, It is hardly necessary to mention, that the plan of the turnout proposed here is that of an inverted curve, with a piece of straight line in the centre.

It is believed that a turnout of from 400 to 500 feet radius, with flexible moveable rails, will be found to answer a much better purpose than those in use at the present time. Several important railroads have curves as abrupt as this. On the Baltimore and Ohio railroad there are two sharp curves, one of 337, and the other of only 318 feet radius.

[From the American Journal of Science and Arts.]

On the Resistance of Liquids to Solid Bodies moving in them.

This is an interesting subject of inquiry, and that branch of it which relates to the greatest practical velocity of boats and vessels appears to be of great importance. Circumstances have occurred within a few years, which have invested this subject with novelty and interest sufficient to engage the attention of scientific men, and roused them from the apathy which generally attends the investigations of physical facts and relations, which were supposed to have been well ascertained. It has been observed when a boat moved in a canal at the common velocities of three, four, or five miles an hour, that a wave preceded her, and greatly retarded her motion; and that if the boat was urged to a velocity of ten or twelve miles an hour, the wave entirely subsided, the bow of the boat being gradually raised out of the water as the velocity increased, and that a less proportional force was required to move her at the greater than at the lesser velocities.

These were all received as startling facts, and caused much theoretical speculation; but they are only such effects as should naturally result from the laws of resistance, which have been determined with considerable accuracy, and some of the effects intimated long ago by the French philosophers, to wit: by D'Alembert, in 1743; by La Place, in 1776; by Bossut, in 1778; by La Grange, in 1786; by Coulomb, in 1800; and by many others at different times in other countries.

La Grange ascertained that a wave of water, where it was one foot deep, moved 5.495 feet per second, and that the velocity of waves of water of different depths are as the square roots of the depths; consequently, the wave in a canal which is four feet deep will move 10.99 feet per second, or about seven and a half miles an hour. As the time in which a pendulum performs its oscillations is in a certain proportion to its length, and not in proportion to the magnitude or intensity of the force which first caused its motion, so the velocity of waves, being a similar motion, is in a certain proportion to the depths of the water, and not to the impulse of the boat which produces them. We ought therefore to expect, as the legitimate consequence of the long established premises, that as the velocity of the wave in a canal depends only on the depth of the

water, the boat, when urged with a greater velocity, must pass ahead of the wave, which will then subside, the cause of its rise and continuance having ceased to act.

We here refer to ordinary circumstances, where the breadth of the canal is three or four times the breadth of the boat, so that the wave has its natural action, and not to a canal so narrow that the boat necessarily pushes the water before her like a piston.

The partial rising of the boat out of the water at great velocities, is caused by the inertia and the mutual attraction of the particles of the liquid, and because the air opposes comparatively very little resistance, or about seven hundred times less than water.

If we take a solid body, whose specific gravity is equal to or greater than that of water, and put it into the water very slowly, we perceive but very little resistance; but strike the water with great velocity, and we find the resistance to be nearly as great as when we strike a solid rock, because it requires a certain time for the particles of any liquid to move among themselves; and if the boat moved with a *very* great velocity, she would of course rise entirely out of the water, and slide on it as though it were ice.

If the boat and water were covered with clarified oil, she would, from the same cause, descend under the water; because the oil would cause a resistance about seventeen times greater than the water; and if the water and boat could be practically covered with alcohol without mixture, the boat would have a small tendency to rise at great velocities, because the resistance of alcohol would be but one third of the resistance of water. The laws of the resistance of liquids in all the various circumstances in relation to it, have not been ascertained with the accuracy and precision which the present state of knowledge of other subjects seems to require; this may be owing in part to some hasty generalizations of the early philosophers, and also to the abstruse nature of the subject. It is now generally admitted that the direct perpendicular resistance of a plane surface, moving in a liquid of indefinite extent, and in a direction at right angles to the plane, is nearly equal to the product of the square of the velocity, the density of the liquid, and the area of the plane. This may be rigorously exact within certain limits, but may not be true when the velocities are very small or very great. It has also been admitted, that when the plane is inclined to the direction of its motion, the resistance is proportional to the *square of the sine* of the angle of inclination. This has been denied, and the resistance stated to be proportional to the *sine* of the angle of inclination. Is it *necessarily* true, that this oblique resistance is proportional to the sines, or some other lines relating to circles, or to some power of them? And is it not possible that the proportion may have a nearer relation to some of the properties of a parabola or an ellipse, than to those of a circle?

In 1778, Bossut and Condorcet made many experiments to ascertain the resistance of liquids. The reservoir of water was two hundred feet long, one hundred feet wide, and eight and a half feet deep. They used a solid in the form of a cube, whose side was five feet; it was sunk four feet in the water, and to one of the sides were attached, successively, triangular prows or bows of various angles, from twelve to one hundred and sixty-eight degrees, and it was moved with different velocities through a space of ninety-six feet.

The results of these experiments exhibit a resistance at all angles greater than the *squares* of the sines, and also greater than the *sines* for angles between 0 degrees and fifty degrees, but less than the sines between fifty and one hundred and eighty degrees. The brief account we have of these experiments appears to be defective, in not stating the absolute velocities of the solid; and the method is also objectionable, because with the lesser angles of the prow, a solid of much greater surface and volume was used than with the greater angles, without making any allowance for these items; so that between the angles of 180° and 12°, the surface in contact with the water, (exclusive of the stern,) was increased from 85 to 335.73 square feet, and the volume of the water displaced was increased from 100 to 337.8 cubic feet. If these circumstances are of no consequence, then a very large vessel

ought to be as easily moved as a very small one.

We want a set of experiments made with solids, all having the same volume or displacement, but having bows and sterns of various forms, to ascertain what form of bow will displace, and also what form of stern will replace, the given volume of water with the least motive force.

To displace the water, and also to replace it, with the least disturbance, is the desideratum. Some attention has been given to the displacement, but very little to the replacement; hence the water lines of boats and vessels, contiguous to the stern and stern-post, are generally concave, which is highly detrimental to fast sailing; because the concavity next to the stern requires a convexity, (before we arrive at the section of greatest breadth,) of much shorter radius than would be required if the water line presented a concavity from the stern to the midship section; and these two curves in contrary directions virtually double the inertia of the water—the concavity throws it off at right angles to the vessel, and it then has to assume a new direction, and pass round a curve of shorter radius to approach the stern. The concavity of the stern retards the replacement, by causing the water to pass along a curve instead of a straight line, which is evidently the shortest; and because the water will not even pass along a straight line, in a direction from the broad part of the vessel to the stern post, when the velocity is considerable, but leaves a hiatus or cavity near the stern post, and deprives the vessel of the benefit of the re-action of the water there—a certain convexity in all the water lines near the stern would therefore improve the sailing.

It may be said that such a vessel would steer badly; but we hear no complaint of the difficulty of steering vessels or boats with pink or sharp sterns. All the water lines should be convex in every part of them. As it is generally admitted that the resistance is in some proportion to the magnitude of the angle of inclination, it is evident that a vessel having a sharp bow will sail faster, with a given motive force, than another vessel of the same displacement, with a blunt or obtuse bow. We may obtain a very sharp bow without sacrificing any other good property, by projecting the lower part of the stern and bow, in the form of a semicircle, beyond a perpendicular let fall from the fore part of the deck.

About ten years ago the writer made a model of a pleasure boat upon these principles, but not then residing near any navigable water, the boat was not built.

The breadth was about two-sevenths of the length, with a very full midship section, and floor of the usual length, and the depth from a deep load water line to the upper side of the keel was about half the breadth. This depth was divided into four equal parts by horizontal planes, as usual, the edges of which are called water lines, and were all convex in relation to the axis in every part. The angle of the bow at the first water line was 28°; at the 2d, 38°; at the 3d, 40°; and at the 4th, or deep load water line, 100°. But by the common method of construction, with the same length and breadth of deck, and a less displacement, the angles would not have been less than 74°, 100°, 140°, and 156°, respectively. According to the results of experiments on the resistance of liquids, a boat or vessel built after this model would not have more than two thirds of the resistance of one built after the models in common use. The bow of this model was formed by extending the keel to a perpendicular line from the fore part of the deck; and from a centre in this line, a little above the second water line, and with a radius equal to the distance from the centre to the keel, a semicircle was described, but not quite completed, being met by another curve from the top of the stern of much shorter radius, and in a contrary direction. The profile will be singular, but not disagreeable when we are accustomed to it.

The water lines consist of different portions of parabolic curves. The curves of the water lines, in the direction from the stem to the stern, were taken from the parabola in a direction from the greatest ordinate towards the vertex. If we draw a rectangle, whose length is equal to the length of the vessel, and whose breadth is equal to half that length, and on this rectangle construct the common parabola, so that the axis shall be coincident with one of the longest sides of

the rectangle, the vertex in one of the angles of the rectangle, and the opposite short side of the rectangle coincident with and equal to a semi-ordinate to the axis of the parabola; then the proper curvatures for certain portions of the several water lines may be found in this parabolic curve, and it is highly probable that all of them may be designated as being between certain ordinates. Perhaps a parabola of greater dimensions may furnish more convenient curves.

The writer has had some experience in the sailing of boats and vessels—is confident that his expectations might be realized, and earnestly hopes that a vessel may be constructed on the principles assumed.

[From the Railroad Journal.]

PROBLEM.

To determine a grade, which will produce the same consumption of power, in a rectilinear railway, as is produced by a level curvilinear track of 800 feet radius, with a given degree of motion.

Solution. Let V denote the velocity of the car in feet per second; R the radius of curvature in feet; W the weight of the car; *m* the distance in feet, through which a heavy body will fall in the first second of time near the earth's surface; G the required grade per mile in feet.

Agreeably to the laws of centripetal forces, $\frac{V^2}{2mR} \times W =$ the centrifugal force of the car; and which expression will consequently exhibit the lateral pressure on the side of the rail very nearly. Hence, agreeably to the laws of friction, $\frac{V^2}{8mR} \times W =$ that part of the moving power which is consumed in consequence of centrifugal force.

From the science of mechanics we therefore have, $5280 : G :: W : \frac{V^2}{8mR} \times W$, and consequently, $G = 660 \times \frac{V^2}{mR} = 41 \times V^2 R$ nearly.

From the above formula it is easy to compute the following table, exhibiting the grades which are equivalent to a curve of 800 feet radius, with different degrees of motion.

Radius of curvature in feet.	Velocity of the car in miles per hour.	Corresponding grade in feet.
800	2	0.440
800	4	1.760
800	8	7.040
800	12	15.840
800	20	44.000

METEOROLOGICAL TABLE,

For the month of May, 1835—kept at Avoylle Ferry, Red River, Lou. (Lat. 31° 10′ N., Long. 91° 59′ W. nearly,) by P. G. Voorhies. [Communicated.]

Days.	Morn.	Noon.	Night.	Wind.	Weather.	Remarks.
1	68	64	63	NW	cloudy	heavy rains and thunder all day
2	58	78	76	calm	clear	
3	68	82	78	..	..	Red river falling
4	70	82	77	SW	..	
5	72	80	78	calm	..	
6	66	81	76	..	..	
7	71	80	77	SW	..	
8	72	84	79	SE	..	high wind
9	64	70	68	NW	..	.. .. —all day
10	60	69	64	calm	clear	Red river on a stand
11	66	82	78	..	..	
12	72	81	76	S	..	
13	74	83	80	..	..	
14	72	86	80	SW	..	
15	64	78	74	N	..	
16	60	77	70	calm	..	
17	58	80	73	..	..	
18	60	78	72	SE	..	light wind
19	71	78	76	..	cloudy	thunder storm at noon
20	71	83	80	calm	clear	cloudy evening—Red river rising
21	70	85	78	..	..	
22	70	83	80	SE	..	
23	70	84	80	calm	..	
24	70	84	75	S	cloudy	little rain and thunder in the evening
25	71	81	78	calm	clear	
26	69	83	78	..	..	
27	68	84	80	..	..	
28	70	84	79	..	..	
29	69	85	81	..	..	U. S. snag steamboats, Capt. Shrives, passed down from the rafts on Red river—left unfinished, 23 to 25 miles: 3 steamboats, 1 keel
30	68	86	83	S	..	
31	72	86	84	..	..	

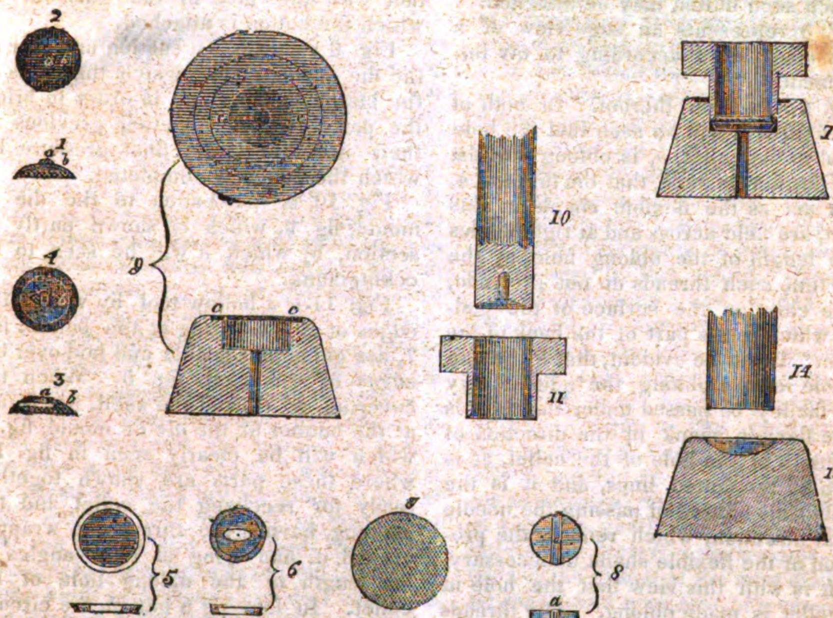
Red river rose this month, 1 foot 0 inches—and is below high water mark, 5 feet 2 inches.

MECHANICS' MAGAZINE,

AND

REGISTER OF INVENTIONS AND IMPROVEMENTS.

VOLUME VI.] OCTOBER, 1835. [NUMBER 4.



[From the London Repertory of Patent Inventions, &c.]

Specification of the Patent granted to JOHN ASTON, *for an Improvement in the Manufacture or Construction of Buttons.*—Sealed July 10, 1834.

My invention (says Mr. Aston) relates to that description of buttons commonly called "flexible shanks," wherein a tuft of thread or woven fabric is made to pass through an opening in what is called a collet, such tuft protruding outwards for the passage of the needle when in the act of attaching this description of buttons to a garment.

Fig. 1 is an edge view, and fig. 2 a plan of one of the old construction of buttons, *a* being the protruding tuft of thread or woven fabric; *b*, the ordinary collet. Objections have been raised against these buttons, owing to the flexible tuft, by which the button is attached, coming in contact with the sides of the button-hole, and quickly wearing the same away, and making it have a shabby appearance; and this has been found to be the case to a much greater degree than with the covered buttons which were formerly very extensively in use, and in which the covering was performed by hand with the needle. Now the intent of my invention is to obviate the objection above mentioned, by an improvement in the construction of the metal collet to be used in the making such description of buttons, by which I am enabled to use a flexible shank which does not protrude, and thus admitting of such buttons being set more closely to the cloth to which they are attached, and as there are no protruding shanks, the only parts which will be within the button-hole of the garment will be the threads by which the buttons are sewed or attached, and in this particular they will very much resemble the buttons covered by hand and with the needle.

My improvement consists in giving to the metal collet of the button an oblong hole, having the threads which act as the flexible shanks laid across the short axes of such oblong hole, as shown in figs. 3 and 4, there being a soft substance or padding below the threads, which comes in contact with the face of the garment to which such button may be attached.

Fig. 3 represents an edge view of a button constructed according to my improvement.

Fig. 4 is a plan thereof. In both of these figures it will be seen that the hole formed in the collet, *b*, is oblong; whilst it will further be seen, that the threads, *a*, which act as the flexible shank in this button, are held across and at right angles to the length of the oblong hole, at the same time such threads do not protrude, but lie close on the surface of the padding, which forms part of the back of the button. It will be evident, that by having the hole formed oblong, the needle may with facility be passed under the threads of the flexible shank in the direction of the length of the hole of the collet, as is shown by the dotted lines, and it is the facility thus offered of passing the needle in that direction, which renders the protrusion of the flexible shank unnecessary, and it is with this view that the hole in the collet is made oblong. The threads which form the flexible shank will be securely held down across what may be called the shorter axis of the oblong hole, only a very small part being left uncovered, and, consequently, will not be liable to stretch.

Having thus described the nature of my invention, I will describe the best manner with which I am acquainted for making buttons according to my improvement.

Fig. 5 represents a metal shell, similar to those which are ordinarily used for making this description of buttons.

Fig. 6 shows the metal collet, the difference between which and those heretofore used is, that the hole is oblong, for the purpose before described. I would here remark, that these shells and collets are made by the fly-press, as is well understood.

Fig. 7 represents a piece of silk, or other woven covering of the button.

Fig. 8 is the padding which lies under the collet, and it has wound round the thread, *a*, as shown in the drawing, which acts as the flexible shank to the button. This padding consists of several layers of soft paper, having a piece of silk or other fabric similar to the covering of the button: this piece of silk, or other fabric, forming the surface which comes in contact with the face of the garment to which the button is attached.

Fig. 9 represents a section and plan of the die or mould into which the parts of the button are first put, in order to bring the parts properly together previous to their undergoing the final pressure by which the button is completed.

Fig. 10 is the punch to the die or mould, fig. 9, which is shown partly in section, by which it will be seen to be countersunk.

Fig. 11 is a hollow tool by which the edges of the covering of the button, fig. 7, are gathered together and laid over the edges of the shell, fig. 5. When the covering, fig. 7, and the shell, fig. 5, are at the bottom of the die or mould, fig. 9, which will be clearly seen in fig. 12, where these parts are shown together ready for receiving the collet and the padding, having the threads, *a*, wrapped around it, and lying at right angles to the length of the oblong hole of the collet. In forming a button, the circular piece of silk or other fabric, fig. 7, is to be first placed on the face of the die or mould, fig. 9, at the points, *c c*, the face of the die or mould being sunk to receive it; a shell, fig. 5, is then to be placed on the surface of the covering, fig. 7, and the two together are to be pressed down to the bottom (by the punch, fig. 10,) of the die or mould, fig. 9, in doing which the punch will enter the shell and guide it down. The punch is then to be removed, and the hollow tool, fig. 11, is to be forced down into the die or mould, by which the edges of the silk or other covering of the button will be forced towards the centre of the die or mould, and, consequently, overlap the edges of the shell; the collet, fig. 6, containing the padding, is then to be dropped into the mould or die through the hollow tool, fig. 11, the collet being uppermost. The punch, fig. 10, is the next to be forced down with pressure through the hollow tool, by which means the collet,

the padding, and the edges of the outer covering of the button, will all be forced into the shell, fig. 5, which will retain them sufficiently secure till the button undergoes the final pressure for completing it. The button thus far produced is to be removed from the die or mould, fig. 9, by a wire, which is passed up through the mould for that purpose, as is the usual practice.

Fig. 13 is another die; and fig. 14 is a punch, by which the final or completing pressure is given to the button. The nature of the counter-sinking of this die will be evident on inspecting the drawing; and it will be seen that the punch, fig. 14, has a plain face. The button, on coming from the die or mould, fig. 9, is to be placed with the collet downwards, and the same is pressed into the die, fig. 13, by the punch, fig. 14, at the same time the workman holds a piece of tissue paper between the button and the punch, to prevent the face of the button being injured in appearance by the punch.

Having thus described the nature of my invention, and the manner of carrying the same into effect, I would have it understood, that I lay no claim to any of the tools or dies or parts of the button herein shown and described, they being similar to those heretofore used in making like kinds of buttons; nor do I claim the making of the flexible shank (or part by which the button is attached) of thread; but I would have it understood, that what I claim as my invention of an improvement in the manufacture or construction of buttons, is the manufacturing or constructing covered flexible shanked buttons with collets having oblong holes, by which the flexible shank is not required to protrude, but the button may with facility be sewed or attached to the garment by passing the needle under the threads, *a*, in the direction of the length of the oblong hole as above described.

Enrolled January 10, 1835.

The following communication is only a commencement of what we hope to be able to give in relation to the "Novelty Works" of this city. There are improvements going on there which will, when completed, astonish those who are not familiar with the operations of the distinguished gentleman spoken of in the following communication. We are not sufficiently acquainted with the works yet to speak of them in the manner they deserve, but shall, when permitted, give a full description of the works, and the improvements introduced for melting iron.

[For the Mechanics' Magazine.]

Mechanical Improvements—Novelty Works.

Mr. Minor: Sir,—In visiting and inspecting the various mechanical improvements in this country, which have come into existence within forty or fifty years, and in learning the history, characters, and doings, of their several introducers, projectors and inventors, one is naturally at a loss which most to admire, the various inventions and improvements, or the talents and ingenuity of their authors.

In connection with the subject of mechanical improvements, I had often heard mention made of Dr. Nott. I had seen several kinds of stoves, both for heating houses and for culinary purposes, said to be invented by him, which I thought displayed ingenuity; and I had seen a steamboat, of somewhat novel construction, which also bore his name, both as inventor and proprietor. But having never yet, to my knowledge, been favored with a sight of that gentleman, and having, through the medium of common report, previously to any knowledge of his mechanical reputation, formed an idea of him as a gentleman of uncommon scientific and literary acquirements—a minister of the gospel of the most distinguished rank—and president of a very respectable collegiate institution; I could not but imagine that though he had by some lucky thought hit upon some improvements in the construction of stoves, and, perhaps, might have some vague, abstract notions respecting the nature and management of steam, in propelling boats, yet his knowledge must be altogether superficial.

But, being in New-York a few days since, and hearing of a large establishment, called the *Novelty Works*, said to be owned by Dr. Nott and others, I procured from a friend a note of introduction to a gentleman who was one of the partners, and visited the place, when, on presenting the note, I was not only permitted to examine every thing in and about the concern, but the gentleman, with the kindest attention and the utmost politeness, accompanied me through every part, and explained every thing which needed explanation.

This examination left no trace of the

impression I had received about the doctor's superficial knowledge. I found an immense establishment, in which were carried on all the different branches and operations, in any way connected with making stoves, steam engines, boilers, and almost every other article of large machinery, and even steamboats; the whole divided into its proper departments, and each department furnished with the most ingenious and perfect apparatus I had ever seen. A spacious yard, which contains the establishment, is enclosed to keep out idle intruders, and each department has a shop by itself. I saw in each department more or less improvements from the common modes of doing the same business, among the most important of which were a steam-boiler and a mode of facilitating the melting of iron, making a saving of heat and time; each of which, and several others, were well worthy of distinct notice. I could not but gaze with wonder on this establishment, with all its system and improvements, that the whole should be planned and directed by the head of one person, who, at the same time, was actively engaged in other avocations of a nature so widely different.

"And still I gazed, and still the wonder grew,
That one small head should carry all he knew."

There was a kind of charm that still heightened the pleasure of this interesting visit, from the recollection that I had often in former days rambled over the ground when it was in open fields, an hour's walk from any part of the city, and hardly, by a common cultivation, reclaimed from the state of nature. The spreading population of the once distant city, with all the din of business, has now reached the establishment; and it seems placed as a corner stone, or as a guide and pattern to the city, to lead them on in the road to perfection.

I quitted this place with reluctance; but if life and health permit, I shall visit it again, and shall notice the several improvements more in detail.

ARCHIMEDES.

We would ask for the following communication an attentive perusal, especially by the mechanics of this State, and others who are opposed to the present system of State prison labor. They will not, we are sure, willingly stand by and see the introduction of the silk manufacture, if, by concert of action, and a continued opposition, they can prevent it.

[For the Mechanics' Magazine.]

Progress of Civilization and the Arts.

It appears, not only from the history of our times, but of all past ages, that the progress from the savage state to that of high improvements in civilization, with its millions of useful arts, is not by gradual advances, but by sudden starts, the effect of some accidental exciting cause; and that whatever may be the state of any portion of mankind, if no such exciting circumstance happens to take place, they will remain in that state, without any advance toward improvement for ages, and perhaps forever. We see portions of the human family which have probably always remained in as unimproved a state as human nature can exist in, and show no signs of ever being otherwise; and we also see other portions which, from time immemorial, have remained with very little improvement, at once awaking, as if from sleep, and in a few years making advances which seem to outstrip the imagination and bid defiance to impossibilities.

Fifty years ago, the various mechanic arts, and the branches of science on which they are founded, were but very little better known in this country than they were to the aboriginal inhabitants five hundred years before. It is true, we had a few men who could make and repair horse shoes and plough-shares in a clumsy manner, but machinery and the fine arts, and even the finer branches of the common arts, were wholly unknown; or, at least, unknown in practice. Even in England, where they are now probably as far advanced as in any part of the world, two or three hundred years since they had made no progress; and throughout Europe the case was nearly the same.

But the art of printing had kindled a flame which was to light the world to an immense field of discoveries, without which it would have remained forever inconceivable. This light had began to spread and to show the outlines of useful knowledge, when the art of spinning cotton by machinery and of propelling that machinery by steam were discovered in England. These together gave an impulse to the spirit of invention, producing effects which no human foresight could have anticipated, and which no one was so credulous as to believe, if it had been foretold.

It is now forty-eight years since the first attempt, and forty-two years since the first successful one, to introduce cotton machinery into this country, and the introduction of steam power has since followed. Before that time many branches of business, which are now too common to excite notice, would have been subjects of extreme wonder; and many things we now see done every day

would then have subjected the person who did them to the charge of witchcraft.

These two inventions, that of spinning by machinery and that of propelling that and other machinery by steam, may be set down as the pioneers which have introduced into this country almost every valuable improvement in the arts which we now possess; they have effected a greater change than ever took place before in any country in four times as long a period. It can be truly said, that in the above short space of time we have progressed from a state of comparative ignorance in the arts to an equal rank with any other nation. We have almost every useful art, carried on in a flourishing condition; and have made and are daily making in many of them valuable improvements. There are now but two important branches which we have not already fairly introduced and carried to a respectable degree of perfection. These are pottery and silk; and these are now in the act of being introduced under circumstances which guarantee their arrival, in a short time, to the highest degree of perfection. We possess all the materials in abundance to perfect the first, and fair specimens are already produced. For the second we have advantages decidedly superior to those of any other nation. It has been demonstrated by those whose knowledge and veracity can neither be questioned nor doubted, that the American silk is superior to that of any other nation; and a thousand facts show that the mulberry, which is the peculiar food of the silkworms, if not indigenous in our soil, thrives in it better than most other trees. The establishment of these two branches will soon make the second great and perfecting era in the history of the arts in this country. The various ornamental branches, as drawing and painting, and other minor parts of the business of manufacturing pottery and silk, will be necessarily improved and extended, and the whole compass of arts will exhibit the effects of new and powerful stimulus.

And it must, therefore, be a subject of regret to every person of patriotic feelings, who understands the subject, that the legislature of this State has, at its last session, passed an act to introduce the manufacture of silk into our state prisons, which, though it proceeded, no doubt, from the purest motives, will, if it has any effect, produce injury rather than benefit.

The business of manufacturing silk is destined, in a short time, to become a principal source of our national wealth; and what is of infinite importance, it seems to be designed by the discriminating eye of infinite wisdom to be almost exclusively the business and employment of females. The first discovery of its use was made by an empress—the labor is more appropriate for women and children than for men, and the fabrics when completed are more particularly designed for their use than for males. Women are, in general, more industrious than men; and are willing to apply themselves more steadily to business, if they can receive adequate compensation. But the use of machinery has relieved the hands of the female community from a great part of the labor which was formerly necessary in clothing themselves and their households. They have not, however, lost their habits of industry, but would cheerfully and proudly pursue and conduct any honorable business which would be productive of profit, and their general habits of economy as well as industry would be a sure guarantee of their success. Thus, while our wives, daughters, and sisters, were helping on the road, not only to competency, but to wealth, without lessening or encroaching on our own proper field of profitable labor, their business would open an increased and extensive demand for such labor in machinery and fixtures. Instead of being taxed to support them for the sake of those charms we so much adore, and which are necessary to our very existence, they will more than compare notes with us in profit, while their charms will not only be increased by wholesome exercise and the expression of self-approbation, but still heightened by more rich and elegant clothing, wrought by their own delicate fingers.

From all these considerations the silk business ought to be hallowed, and sacredly appropriated to the department of female management. No man ought to engage in it any farther than as an assistant, to furnish the necessary fixtures, and to aid in cultivating the trees, and also to prepare the machinery necessary in manufacturing it. At the heads of this noble department our females will feel new importance in scale of being, while they are not only clothing and adorning their persons with the richest fabrics of their own making, but adding immense sums to the national wealth. Under these circumstances, will they not feel their rights invaded and encroached on—their prospects and profits interfered with? and what is still worse, will they not feel themselves insulted and degraded by the proposed competition with them in the state prisons, and by making them fellow laborers with base wretches whose crimes have deprived them of liberty, and shut them from the sight of mankind? If they do not feel all this, and feel it with the spirit of strong resentment, they are not the beings we think them.

But besides all this, there is no other branch of business in the whole compass of the useful arts so completely unfit for the employment of convicts in a state of con-

finement—so sure to defeat the object the legislature had in view, (which was doubtless to make the convicts earn their living without interfering with the rights of free citizens,) as the culture and manufacture of silk. The business of planting and cultivating the mulberry trees we should certainly think inconsistent with the state of confinement in which they must necessarily be kept. The feeding and taking care of the worms is much more appropriately the business of women and children than of men, even if the prices of the labor were the same. The reeling the silk has ever been, and must always be, the business of females; the rough and large fingers of men are unfit for it. All that remains, then, is the weaving and dyeing. The weaving by the power loom is already commenced by Mr. Gay, at Providence, with the most perfect success, and all plain silk fabrics will soon be woven by it; and every man acquainted with cotton manufacturing, knows that women are better attendants on the power loom than men, independently of the difference in prices of labor. For weaving figured and other fancy articles much skill is necessary, which can only be acquired by a thorough education in the intricate branches of weaving, and will require complicate and expensive machinery. The dyeing might, perhaps, be done at the state prisons to advantage, where the goods are manufactured in the neighborhood; at any considerable distance the profits would not pay for transportation.

This is no exaggerated statement—no distorted picture of the case. It will be found on trial to be the plain truth in every particular. Who then will advocate the introduction of silk manufacturing in the state prisons? We think no one who possesses a knowledge of the facts, and who is in his sober senses. S. B.

Delaware and Raritan Canal.

To the Editor of the Mechanics' Magazine:

Dear Sir,—I have just passed over the Raritan and Delaware canal, which I found in excellent condition for navigation. You are, doubtless, aware that this canal was originally designed to accommodate the coasting trade, by which the delay, hazard, and expense of the route round the Capes would be materially obviated. In this respect it is an important communication; but, like most other improvements in facilitating intercommunication, it is found to be highly beneficial in promoting other objects than those originally contemplated. By means of tow-boats it affords a very cheap and expiditious transportation between New-York and Philadelphia.

The tow-boats, or barges, are towed through the canal by horses, and on tide water by steam-boats. The barges carry from 100 to 150 tons, and are drawn through the canal by two to four horses. Barges of over 200 tons have passed through the canal. The latter, however, are too large for convenient management, and it is considered, by those navigating and managing the canal, that barges of 100 to 150 tons are best adapted to its navigation. This size appears to move with ease, and are very conveniently governed by the common tiller. I saw a loaded schooner of about 100 tons moving at a velocity of two miles to the hour, drawn by two common horses. The horses worked moderately, and appeared to make no more than ordinary effort. The barges tow easier than the sail vessels of same burthen.

A daily line of packet boats has recently been established. One of the packet boats is on the Burden plan: having two long cylinders placed about 10 feet apart, on which the cabin is supported. I saw this boat moving (by three horses) at the rate of about 7 miles per hour. The horses did not appear to labor as much as they do on the packet boats of the Erie and other small canals that I have seen when moving at the rate of 4 miles per hour. The swell created by this boat was less than that made by packets on the Erie canal at four miles per hour. The appearance was fine: the horses trotted along without any extra effort, and the boat glided elegantly through the water. The average speed of the boat, including all detentions at locks, &c., is 7 miles per hour.

The length of the canal is 43 miles. The locks are 24 feet wide and 110 feet between gates. The depth of water is 7 feet, and its minimum width 70 feet. I observed, however, that a great portion of it was from 80 to 100 feet wide.

Experience on this canal exhibits the great economy in transportation on large canals over small ones; and as the expense of construction is not as great in proportion for large canals as for small ones, it therefore seems highly important, when a *large trade* is to be accommodated, that the canal should have liberal dimensions. In the great canal communications between the Atlantic and Western states, sufficient attention has not been paid to making the navigation the most perfect and economical that was practicable. The length of those canals, and the great amount of property that will ultimately seek a market through them, will demonstrate their want of suitable adaptation to the great and growing trade they were designed to accommodate. The projectors appear only to have viewed the great superiority of a common or small canal over turnpike roads. This, when designed to accommodate the transportation

for short distances, and comparatively for moderate amount, would, doubtless, have been wise; but when applied to lines hundreds of miles in length, where the transportation was materially affected by the value of the article transported, and where the amount of trade is great, this policy does not meet the case. It should not, however, be forgotten, that those canals, already made, were planned in the infancy of trade, with limited knowledge in the science of canals; and it is, therefore, matter of pride, that in a country so recently reclaimed from a wilderness, we have done so much. At the same time it would be unwise not to profit by experience in our future operations in constructing canals.

Respectfully, your ob't sv't.

[For the Mechanics' Magazine.]

To set out the Holes in the Circles of the Index to a Machine for Cutting the Teeth in Geer Wheels.

Rule. Take several convenient numbers for a circle that is most used, and find the least common multiple of them, by the rule laid down in Pike's Arithmetic, page 69.

Example 1. We will select for the first circle the numbers 12, 16, 20, and 24.

4)	12 .	16 .	20 .	24	
3)	3 .	4 .	5 .	6	
2)	1 .	4 .	5 .	2	
	1 .	2 .	5 .	1	= 240

Example 2. We will next select for the second circle 10, 15, 21, 25, and 30.

5)	10 .	15 .	21 .	25 .	30	
3)	2 .	3 .	21 .	5 .	6	
2)	2 .	1 .	7 .	5 .	2	
	1 .	1 .	7 .	5 .	1	= 1050

2d circle.

Example 3. For third circle, 40, 60, 80, and 100.

10)	40 .	60 .	80 .	100	
4)	4 .	6 .	8 .	10	
2)	1 .	6 .	2 .	10	
	1 .	3 .	1 .	5	= 1200

for 3d circle, &c.

By the above rule, I have calculated the holes for several circles, which are as follows:

1st, A circle of 240 holes will cut 120, 80, 60, 48, 40, 30, 24, 20, 15, and 12 teeth.

2d, A circle of 144 holes will cut 144, 72, 48, 36, 24, 18, 16, and 12 teeth.

3d, A circle of 200 holes will cut 200, 100, 50, 40, 25, and 20 teeth.

4th, A circle of 72 holes will cut 72, 36, 24, 18, 12, 9, 8, and 6 teeth.

5th, A circle of 132 holes will cut 132, 66, 44, 33, 22, and 11 teeth.

Which is the most that is in common use.

S. A.

[From the Journal of the Franklin Institute.]

On the comparative Corrosion of Iron, Copper, Zinc, &c., by a saturated solution of common salt. By A. D. Bache, Prof. of Nat. Philos. and Chem., Univ. Penn.

To the Committee on Publications.

Gentlemen,—An inquiry was addressed to me some months since, by Mr. Joseph S. Walter, Jr., in relation to the material which would be most proper to be used for pipes to convey a strong solution of common salt to a pump intended to raise it, and for the material of the pump itself. From this solution it was intended to recrystallize the salt. The circumstances being of a somewhat complex character, I determined not to be satisfied with the indications of general theory, but to try the experiment, under the circumstances of the case, as nearly as might be possible. The materials in relation to which inquiry was particularly directed, were iron, copper, brass, lead, and zinc. Of these, the rapid oxidation of iron, when exposed to a solution of common salt, is well known; the corrosion of copper by sea water is also well known; the influence of the earthly muriates contained in the ocean prevents this case, otherwise very closely resembling that in question, from corresponding precisely to it, the common salt referred to containing these muriates only as impurities. Zinc does not decompose water readily, and oxidates very slowly, even when exposed to the combined action of air and moisture; it also ranks below sodium in the list of electro-positive metals; its chloride, however, is soluble. Lead is readily acted upon by the combined agencies of air and water, first oxidating, and then passing to the state of a carbonate; its place in the list of positive electrics is below zinc, and, of course, below sodium, which latter we should expect, therefore, to have the greater affinity for chlorine; the protoxide of lead, however, and several of its salts, interchange elements with chloride of sodium. The chloiide of lead is insoluble, and hence the presence of soluble muriates acts as a protection against the corrosion of lead by water.

As the experimental results directly obtained may possibly prove of value to others than the estimable individual for whom they were to be applied, I have thought it right to put them on record.

The materials used were iron, copper, brass, lead, and zinc, the metals being as presented in commerce, and, therefore, probably not quite pure. They were prepared in rectangular plates, about two and a half inches in length, and three fourths of an inch in width, and varied in thickness from .03 to .07 of an inch. These were placed in glasses containing saturated solutions of

common salt, rather less than one fourth of an inch in depth from the top of each plate being left exposed to the air. The vessels were left uncovered, and the evaporation of the water of the solutions was supplied from time to time during the exposure. The temperature in the room in which the vessels were placed, was not very different from 50° Fahr. during any part of the time.

After an exposure of about three weeks, the plates were removed from the solutions, and carefully washed and dried. Having been weighed before placing them in the solutions, they were now again weighed, and the loss of weight ascertained.

The iron plate was found covered with oxide of iron, strongly adhering to it in part, and in part deposited at the bottom of the glass containing the solution. There was upon the upper plate, and in the glass, a deposit of proto-chloride (white) of copper, colored by carbonate of copper, and a similar deposit upon the brass plate. The lead and zinc had been, to all appearance, very slightly acted upon; there was upon the latter a white deposit, probably of oxide of zinc.

The following table shows the amount of surface actually exposed to the solutions, the weight of the entire plates, and the loss of weight by the exposure. I have not reduced the weights used to grains, because the object is merely to obtain comparative results.

Material exposed.	Surface exposed.	Weight of plate.	Loss of weight.
Name.	Sq. inch.	Grammes.	Grammes.
Iron,	4.656	6.320	.312
Copper,	3.936	10.720	.058
Brass,	4.138	5.150	.029
Zinc,	4.572	6.115	.003
Lead,	4.762	20.080	.013

From the foregoing data I have calculated, below, the loss of weight, in grains, which a surface of forty square inches, or a plate of twenty inches on each surface, and very thin, of the materials would have suffered, and the relative loss by each material, referring to that which lost least, namely, the zinc, as the standard of comparison.

Material.	Loss of w'ght by 40 square inches of surface.	Comparative loss by exposure of same surface.
Name.	Grains.	Ratio.
Zinc,	0.40	1.00
Lead,	1.68	4.20
Brass,	4.31	10.78
Copper,	9.07	22.68
Iron,	41.27	103.18

The corrosion of the iron, with the same extent of surface as zinc, and exposed to a solution of common salt for the same length of time, is thus shown to be upwards of one hundred times that of the zinc. The zinc appears to protect the copper in the brass, probably by rendering it electro-negative, and thus diminishing the affinity of the chlorine, which would otherwise destroy the copper.

Since the experiments indicate zinc and lead as the materials to be selected from those named, on account of the slight corrosion which they suffer, lead would obviously have been the material selected for the pipes to conduct the solution of salt to the pump, and zinc for the material of the pump, the selection depending upon well known properties of these metals.

The coatings formed upon both the lead and zinc, would protect the underlaying surface from action, unless removed by mechanical force.

On Light.—Nothing can be more interesting to the philosophical horticulturist, than the phenomena of the influence or agency of light in the process of vegetation. It has been very commonly asserted, that the germination of seeds cannot be effected under the agency of light; but this is one of the fallacies which have originated in dogmatical assertion, and passed current among superficial observers. Seeds are generally buried too deep; the greater number of them, it may be admitted, develope their radicles and seed leaves best when they are covered with a very shallow stratum of light, moist earth; but numbers would perish and never rise at all, were they not sown upon, and not under the surface of the soil; witness the seeds of the birch, the azalea, the kalmia, &c.; and others (even of the common garden seeds) will swell, send out first their radicles upon and then into the soil, and shortly after produce and elevate the plumules, and become perfect plants. Any one may assure himself of these facts, by laying seeds upon the flattened and moistened surface soil of a garden pot in any stove, vinery, or hot-bed.

Our chief object, however, is to solicit the attention of the scientific reader to the effects of light upon trees and shrubs under glass roofs. Experience appears to have assured us that the coloration of leaves and flowers is effected by the presence of solar light; but in particular

and individual instances, the effects of this mighty agent are widely dissimilar. The beautiful camellia courts shade; the tender leaves of the vine, on the contrary, seem to revel in the utmost power of a mid-day sun, while the erythrinæ elevate every leaf and leaflet, as if they would drink in the sunbeams. The orange tribe seems to be peculiarly influenced by light during the winter months.

It was lately communicated to us from a quarter which claims the utmost attention, that a set of orange-trees in a house, where the foliage was far below the glass, dwindled, or became very unhealthy; but that upon bringing them much closer to that medium, a manifest change was effected, and the trees assumed so rapid a growth, that they would have pushed through the glass had they not been removed to a house with a higher roof.

How do the solar rays act through the medium of glass?

That they are more or less radiated and dispersed, cannot be doubted; and in proportion as the plant is removed from the glass, the wider and more dispersed will the portions of the rays become; and in inverse proportion will be the power of these broken rays. In our answer to our correspondent, we suggested that the solution of the phenomena might be found in this dispersion of the rays; and consequently, that just in proportion as the head of the tree or shrub approximated to the glass, the less would be the dispersion, and the greater and more direct would be the solar influence. We find this idea is confirmed in the effect produced upon the leaves of the pine apple plant (*ananassa.*) If the plant be near the glass, unshaded by other foliage during the height of summer, the growth is much arrested, and a deep red or brown tint is suffused over its surface. In the damp dells, and in the mass of shade in the forests of Sierra Leone, where the pine apple is immersed in a pestilential atmosphere, loaded with vapor as that of a steam bath, the leaves are of an intense sombre green. One of the most profound philosophers of the day, whom we consulted on this mysterious agency of light, while he admitted that the dispersion of the rays might be considered an influential, though not the sole actuating cause of the phenomena, suggested that a greater heat and drier atmosphere prevailed in the upper part of the orangery; and that these might also be considered agents in the promotion of the more healthy and luxuriant growth. While we see the beneficial and astonishing effects of direct solar light, we cannot but feel surprised at the prejudiced practice which still prevails in the culture of the beautiful citrus family. Everywhere its subjects are immersed in sombre gloom, and everywhere they dwindle, and are the prey of coccus and disease. No plants are of more easy culture, and none possess greater interest. The orange tribe of plants merits a conservatory in its own right; and therein uninterfered with by other foreigners of dissimilar habits, and protected during the entire year, they thus would flourish in luxuriance, and we assuredly believe would bear abundance of perfect and delicious fruit.—[Scientific Tracts.]

The following address to the Mechanics of Easton, Pa., will be found well worthy of a second, aye, of an ft-repeated perusal. It is in a style which every mechanic and every apprentice can understand; and it states facts which it is important for every practical man to know. It refers to individuals who have, by the force of talents, industry, and perseverance, arisen from obscurity and indigence to the most honorable stations in the history of the country and of the world; to men who have conferred benefits upon mankind beyond the power of man to estimate and appreciate; and, what is of more importance, it indicates the path by which they arrived at that station, and, therefore, the course for others to pursue who would become, like Rittenhouse, Fulton, and Evans, the benefactors of mankind.

An Address to the Mechanics of Easton, Pennsylvania, delivered at their request, by James Madison Porter, on the 4th of July, 1835.

In comparing man with the rest of the animated part of creation, it will be found that his superiority consists not in his animal powers or capacities. He has neither the strength nor the speed that characterize the greater portion of the brute creation, and enable them successfully to attack or defend. He is, of all animals, the most helpless in infancy, and the least capable of enduring the changes of the seasons and the inclemencies of the elements. His imbecility and incapacity to take care of himself is continued through a long infancy, and even in the maturity and vigor of man-

hood, his physical powers are of an inferior order. Whence, then, does the superiority of man arise? It is from *the mind*, the immaterial mind, which enables him to lord it over the rest of creation, and make them subservient to his wants or caprices. Well then might the poet say,

> "I would be measured by my soul,
> The mind's the standard of the man."

Philosophers have been much divided on the subject of the powers of the mind—whether the mind is a mere capacity for improvement which requires something to evolve it, or whether talents are innate. It matters, however, but little which is right, In either case the improvement of the mental faculties, by reading and study, developes its capacities and enables it to bring its resources into practical use.

In considering the subject to which your attention is now necessarily called, it will be attempted, in some slight degree, to trace the influence of mental developement in relation to the mechanic arts—which at this day must be considered the most beneficial, practical illustration of natural philosophy, as applied to the ordinary useful purposes of life.

In the infant ages of mankind, the mechanic arts were little practised. Man's first lot was probably in the mild regions of the equator, where the great luxuriance in the products of nature, and the little occasion there existed for the erection of buildings to shelter him from the inclemency of the weather, or the procuring of much apparel for the same purposes, were illy calculated to elicit the mechanical powers or principles lying like an unsprouted germ in his mind. Necessity has ever been the mother of invention, and thus we see that ere this globe was visited by that deluge which swept all the human-family, but the favored household of Noah, from its surface, which had been overspread by wickedness, the necessities, the conveniencies, or the curiosity of man, had induced considerable progress in the mechanic arts. We learn from the word of sacred truth, that in a few generations from the great progenitor of mankind, and perhaps even while he yet lived, cities were builded, musical instruments constructed, and mechanism in metals carried on. Cain built the city of Enoch—Jabal was the father of such as dwelt in tents and have cattle—Jubal of such as handled the harp and organ—and Tubal-cain an instructor of artificers in brass and iron.

At the period of the deluge, something over sixteen centuries and a half from the creation, there is no doubt that considerable perfection had been attained in many of the useful and practical branches of mechanism. The ark itself was perhaps one of the best specimens of art for the purpose for which it was intended, that ever was produced, for the great Jehovah himself condescended to be the instructor of its immediate maker; and wherever he has set an example of mechanical skill or arrangement, every thing merely human stands back abashed. Subsequent to the deluge which destroyed the earth that *then was*, and gave man this *new earth* which we now inhabit, and which exhibits so many geological proofs of the existence of that deluge, and the accuray of the Mosaic account of the creation and early history of the globe, the mechanic arts were practised and extended, as the increase of the human family spread them abroad on the earth, as the extent of light and knowledge, and consequently the refinements of life, prevailed.

It would be out of place here to attempt a history in detail of their progress in the various arts and sciences. Much pains and labor have been bestowed on this subject to unbosom from the monuments or rubbish of ages the claims of nations and of people to the rank of pioneers in the works of art.

The cities of Babylon and Nineveh were built some 250 years *before* the time at which the best authenticated accounts fix the commencement of the first of the pyramids of Egypt; and the confusion of tongues at the attempted erection of the tower of Babel must have preceded the commencement of the first pyramid between 50 and 100 years.

The erection of the first of these pyramids is ascribed to Apachnes, the third of the race of shepherd Kings of Egypt, about 2,095 years previous to the birth of our Saviour, and some years previous to the time when the patriarch Abraham visited Egypt; and it is evident

from the skill exhibited in their structure, the immense masses of stone of which they were composed, the order and system with which they were planned and executed, as a consequence from which, they have endured, in defiance of time and the elements, until the history of the men and nations that reared them has been nearly lost to the world, and only known by the unravelling of the hieroglyphics which abound in them, that the principles and practice of permanent and durable architecture had then attained to considerable perfection, and that much of mechanical skill must have been used in removing the material from the quarry; in conveying it to and depositing it on the building, and in dressing and finishing each block for its appropriate place.

It was not, however, in architecture alone, that the advance in the mechanic arts was exhibited. From the rude coverings of skins, the first garments worn by the ante-diluvian world, subsequent to the expulsion, the ingenuity of mankind had invented the construction of fabrics as well for garments as for tents. Subsequent to the deluge, and as far back as 1850 odd years before the Christian era, when Eliezer of Damascus was sent by Abraham to the land of his brethren to obtain a wife for his son Isaac, he takes with him golden earrings and bracelets, as presents for the intended bride, and we find them having pitchers and other utensils of convenience in housekeeping—and the bride, when she met her future husband, was veiled.

The making of bricks, we have authentic accounts, was in use more than 2000 years before the Christain era. The erections of the buildings before mentioned—of the ark by the Israelites in their journey—of the various heathen temples of Egypt, Greece, and Rome—the splendid temple by Solomon—and the Colossus at Rhodes, with other instances among other nations, until the overthrow of the Roman Republic, and the establishment of the Empire, show, that at and before the Christian era, great progress had been made in various arts, tending to minister to the necessities and luxuries of mankind.

The Grecian models of architecture have never been excelled in elegance. The Greeks understood the laws of proportion in the construction of their edifices, in an especial manner. Yet there were many principles in natural philosophy little, if at all, known to them. The principles of hydraulics, which are not yet fully known, were then even less perfectly understood. They knew not that water would rise to its own level; and hence, instead of the simple modern resort to conduit pipes, they incurred immense expenses in rearing arch piled upon arch, to construct their acqueducts to carry large supplies of water over depressed spots of ground.*

Archimedes flourished about 260 years before the birth of our Saviour. Whatever might have been known in practice previously, there was little of the theory of mechanics philosophically understood. He has the credit of discovering the exact operation and power of the screw, the inclined plane, the pully, and the lever—of the latter of which he was so enamored as to say to the second Hiero, King of Syracuse, "Give me a place to stand on, and I will move the world." And yet it would seem that these, or some at least of these powers, must have been in use among the Egyptians some fifteen to eighteen hundred years before, or how could the immense masses of granite and other stone forming the walls, the columns, the colossal figures, and other monuments of ancient Memphis, Abydos, Antæopolis, and Thebes, ever have been raised from their natural beds, and transported to the temples, the grottos, the sepulchres and other edifices which they, in part, composed or decorated?

From the days of Archimedes onward, the science of mechanics was taught in the schools. The philosopher and mathematician searched further into the theory, whilst the result of their investigations was put in use by practical artisans, and submitted to the unerring test of experience. In the dark ages, which succeeded, as the Roman Empire declined

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* Pliny informs us that water can be raised by tubes of lead, and the excavations at Pompeii would show that, at and before the reign of the Emperor Titus, baths and fountains were thus supplied. But even among the Romans they knew no material of sufficient tenacity for large supplies of water, if they indeed supposed that conduit pipes could be used on so large a scale.

and fell, and ignorance and superstition wrapped the world in their sable habiliments, there was little of improvement in the mechanical branches of science, and little of practice, except in the branch of architecture, and those domestic arts with which the world could not dispense.

It was not until towards the close of the 16th century that the rapid developement of the physical sciences commenced; and there is not perhaps on record in history any more extraordinary contrast than that of the slow and limited progress of those sciences, from the early ages of mankind up to that time, and the rapidity with which they have since been enlarged and spread abroad.

Until the art of printing was discovered and put in practice, the additions to the stock of knowledge on all subjects were few and far between. The mass of mankind were little interested in them, and if the observations made and the knowledge acquired by a few enquiring minds in any age were not lost in oblivion, they were not spread abroad. It seemed to be a part of the philosophy of the ancient and the monastic school to keep their knowledge wrapped up in learned mystery, as a thing too sacred for common observation. It was not then supposed that the sciences could exist in, and be illustrated by, common objects, and have a place in the Mechanic Arts. But, no doubt, many a bold and adventuring mind did push its enquiries beyond the ordinary routine, and taking its flight into the regions of speculation, made valuable observations, which failed to benefit mankind, because they perished without a record. Towards the middle of the 16th century, this art of printing, of all others the most valuable to mankind, was discovered, and by the commencement of the 16th century, had come into pretty general use, and enabled every one to make his ideas known to the world. On this subject it has been well said: "The moment it took place, the sparks of information, from time to time, struck out, instead of glimmering for a moment and dying away in oblivion, began to accumulate into a genial grow, and the flame was at length kindled which was speedily to acquire the strength and rapid spread of a conflagration. There was an universal excitement in the minds of men throughout Europe produced by the first outbreak of modern science, but even the most sanguine anticipators could scarcely have looked forward to that steady, unintermitted progress which it has since maintained, nor to that succession of great discoveries which has kept up the interest of the first impulse still vigorous and undiminished. It may truly be said, that there is scarcely a single branch of physical enquiry which is either stationary or which has not been for many years past in a constant state of advance, and in which the progress is not at this moment going on with accelerated rapidity."

There is an active principle in the human mind which is elicited by excitement, but which, unmoved, is inert. As in water, so in mind. The stagnant pool soon becomes putrescent. The turbid and agitated ocean is healthful and pure. 'Tis the action of the waters that secures their purity. The diffusion of knowledge has tended to the increase of civilization and wealth. These, in turn, have given opportunity to the diffusion of taste for intellectual pursuits; and to the increased and enlarged opportunities afforded from the 16th century to the present time, we must mainly attribute the great extension of knowledge in every thing connected with science and the useful arts. Mind has been brought into competition and collision with mind. Scientific truths have been developed and tested, and brought to bear on the common affairs and business of life.

These results have been attained in all the arts and business of man. The age in which we live may emphatically, beyond all others, be said to be the age of mechanics; and much as we have progressed, we must not flatter ourselves that we have attained perfection in any of them. As much as we are beyond those who preceded us, in all probability, we shall fall behind those who succeed us. The impulse is given: the mind of man is pursuing the investigation of the *useful* — the knowledge of one age is transmitted to the next, and so we may increase upon increase until, the command will go forth that "Time shall be no more." Nor will the increase and developement of our faculties then cease.

Adam Smith, in his "Wealth of Na-

tions," describes a philosopher as a person whose trade it is to do nothing, and speculate on every thing. If Adam Smith had lived at this day, he probably would reverse this definition; for the great, vast, and most beneficial results which have been attained, in increasing the wealth of nations, of which he wrote much and perhaps knew but little, have been thus attained by the labors of philosophers, systematically applying the principles of true science to the improvement of the Mechanic Arts. It is principles which are the objects of enquiry to the natural philosopher, and the elucidation of a truth may be completely accomplished by the most familiar and common-place facts. In truth, philosophy in modern days has descended from its stilts, and mixing in the common affairs and business of life, is, by the elucidation of its principles in a familiar manner, become the common acquaintance of all who reflect. The observation of the fall of an apple, led the immortal Newton to the discovery of gravtiation, and other things, equally common and apparently trivial, have led to other important results. To the natural philosopher there is no natural object unimportant. From the last of Nature's works, the greatest lessons may be learned. The scientific mind applies principles readily to every incident as it occurs, and finds improvement and delight in the pursuit. He finds

"Tongues in trees—books in the running brooks—
Sermons in stones, and good in every thing."

"Accustomed," says an able writer, "to trace the operations of general causes and the exemplification of general laws, in circumstances where the uninformed and unenquiring eye perceives neither novelty nor beauty, he walks in the midst of wonders. Every object which falls in his way elucidates some principle—affords some instruction, and impresses him with a sense of harmony and order. Nor is it a mere passive pleasure that is thus communicated. A thousand questions are continually arising in his mind—a thousand subjects of enquiry presenting themselves which keep his faculties in constant exercise, and his thoughts perpetually on the wing, so that lassitude is excluded from his life; and that craving after artificial excitement and dissipation of mind, which leads so many into frivolous, unworthy, and destructive pursuits, is altogether eradicated from his bosom."

It may be asked, "What has all this to do with the present occasion?" The answer is, that every mechanic art is the reduction to practice of scientific principles. The carpenter or mason who lays out his building by the use of the base 6, the perpendicular 8, and the hypothenuse 10, or corresponding numbers, has the demonstration that he is laying out the building at right angles, in the 47th proposition of the first book of Euclid's elements;—the sum of the squares of the base and perpendicular being equal to the square of the hypothenuse. They, too, will more fully understand how to spring their arches and truss their girders, by understanding the principles upon which the means used accomplish the ends intended, than in the mere copying, without reflection, the work of others. For although a theorist, without practice, would, in all probability, erect but a sorry edifice, yet where a knowledge of principles is combined with practice, the advantage is apparent to all. The tanner, in preparing his leather, is a chemist in practice—so, too, the saddler and shoemaker, even in the preparation of their wax ends, in giving proper consistency and tenacity to the materials used, independent of the philosophical principles in the shapes and forms of their work, and its adaptation to its intended purposes.

It were endless, however, to enumerate all the examples of this truth in the trades and occupations here assembled. It exists in them all, and the instances I have cited are perhaps the least striking of any that might be given.

What was it that raised David Rittenhouse, a native of Pennsylvania, above the ordinary clockmakers of the country in which he lived, and placed his name high among the learned of the world? What was it that raised Brindley, from an apprentice to a Derbyshire millwright, to one of the greatest engineers and mechanics which the world ever produced? Neither of these great men originally received more than the rudiments of an English education. It was the application of their giant minds to the study of principles that placed the one at the head of the philosophers and astronomers of

his time, and made the other the companion and the adviser of the King, Lords and Commons of his native land, so that scarcely any public work was entered upon without his superintendence and advice.

And what too placed Fulton, another son of Pennsylvania, so high in the estimation of the world?—It was not his birth. It was not this world's wealth. It was the cultivation of his mighty intellect, which, but for his *reading* and *reflection*, like the diamond in the mine, might have lain obscure, unnoticed and unknown.

Oliver Evans, of Philadelphia, in his day, and that too within the recollection of him who now addresses you, was esteemed a crack-brained enthusiast, when he avowed that the child was then born, who by the force of steam should travel from Washington to New-York in a day.

His language was, "People will travel in stages moved by steam from one city to another, almost as fast as birds fly—fifteen or twenty miles an hour." "A carriage will set out from Washington in the morning, the passengers will breakfast at Baltimore, dine at Philadelphia, and sup at New-York, the same day."

The first of these assertions has been accomplished, and the second will be, before we are three years older. Yet this man, when in 1787, he petitioned the legislature of Pennsylvania for encouragement and assistance, to test the possibility of using steam as a motive power for wagons or carriages, was considered *insane*.

Oliver Evans was originally an apprentice to a wagon maker or wheelwright. But he was a boy who thought and read, and his attention was called to the expansive power of steam by the heating of a gun barrel in a blacksmith's fire, in which about a gill of water had been confined. He read and reflected, until he made as great an improvement in the use of steam, as perhaps any who preceded him.

As steam has been referred to, let us for a moment advert to the mighty engine it has become in the hands of men. Its expansive power was known to the ancients: "The elegant toys of Hiero—the beautiful experiments of Porta and Decaus—the modification of the Greek machine by the Italian Branca—the ingenious ideas of Hautefeuille, and their masterly extension and developement by Papin, contain all the rudiments required for a perfect machine, wanting only to be touched by the magic hand of some mechanical magician, to form a structure of surpassing ingenuity and semi-omnipotent power."

The total neglect with which these individual schemes were regarded, is not the least extraordinary circumstance in the history of the steam engine. And when the Marquis of Worcester, towards the close of the seventeenth century, made his first attempt, imperfect as it was—yet successful, in applying steam as a moving power, he was unable to interest the public in the matter, and it fell almost, if not entirely, into oblivion, until Captain Savery, thirty years afterwards, succeeded in combining a mechanism in which steam or elastic vapor was the motive power. Newcommen carried it somewhat farther. The improvement thence progressed, until the invention of Bolton and Watts, perfected, as was supposed, the system of condensation, so as to give the greatest possible power to a given quantity of steam generated. Our own Fulton adapted it in practice, the first successfully, to the propelling of boats, and, in the short period he lived thereafter, not less than fifteen steamboats were built and put in use, under his own direction. Suffice it to say, that it is now used as the motive power for almost every purpose. Steam has added to the productive faculties of Britain what would be equal to some hundreds of millions of operatives; and what has it not done for our own country, where the price of labor is higher than in foreign countries?

Steam and water, by the aid of improved machinery, are accomplishing wonders, and indeed it would seem that we knew not where the perfection of machinery will end. This much we do know, that we must keep pace with the improvements of the times. Who now would think of making cut nails with the hand, machine in use less than thirty years since? On a recent examination before the House of Commons in England, it was testified, "A cotton manufacturer who left Manchester seven years since, would be driven out of the market by the men who are now living in it, provided his knowledge had not kept pace with

those who have been, during that time, constantly profiting by the progressive improvements that have taken place in that period."

There is a very common error existing among those who have never reflected on the subject, that these improvements in the Mechanic Arts which have so increased and economized the products of labor, are prejudicial to individuals, by depriving them of work. All experience has shown that it is not the result. The reduction of price always increases the quantity sold in a corresponding degree, and thus the amount of labor which must be done by hand, is kept up, so as to give equal, if not increased employment to operatives. To give a familiar illustration:—Some years since all the floor boards used in our cities, were planed, tongued and grooved by hand; now they are principally, if not altogether, done by machinery. Sash, too, in all our large cities, until lately, were made entirely by hand; now they are made in many places by machinery. In both these items, the prices of the article have been reduced fifty to seventy-five per cent. Many carpenters were apprehensive that these things would ruin their business, and throw them out of employment. Has such been the result? On the contrary, has there not been an increased demand for carpenters in those very cities, from the fact that the diminished expense of building in consequence of these and other improvements by labor-saving machinery, has induced so many more persons to invest money in buildings? and has not the price of labor among carpenters been so enhanced, that many have gone from the country to the cities, induced by this advance in wages?

Now, believe me, such will ever be the case in every branch in mechanism and manufactures.

The invention of the spinning wheel undoubtedly threw hand spinners out of employment at hand spinning, but gave them increased employment at other branches, in consequence of the increased demand, from their reduced price, for the articles spun.

So, too, with power looms—so, too, with the carding machine—the cotton gin—the last of which actually doubled the value of the cotton lands to the planter; and who now never sees a pair of hand cards used, unless it be for some very special purpose.

All these things had the effect of changing the direction of labor, and yet no one will doubt but that they have all tended to advance the interests of the community at large; and it may be laid down as an axiom in political economy, that, whatever benefits the community at large, must eventually benefit all the members of that community.

The great object which I have had, in throwing together these desultory observations, has been to call your attention to the propriety, nay, necessity, of improving yourselves in your various callings and trades, by learning, in addition to the practice, the principles on which your work is done—in other words, to ask you to think, to reflect, to read and learn what others have done before you, and to add your own experience to the existing stock of knowledge.

The mechanics of our country, and I flatter not when I make the assertion, are as useful and valuable a class of citizens as our country contains. In general, they may be said to fill that happy medium position in society, in which neither overgrown wealth nor abject poverty is found. To this there may be, and are some exceptions, but not enough to operate against the truth of this, as a general assertion. The question you are asked to answer fairly, and truly, is, Have you availed yourselves of all the means placed within your reach, to increase your own resources, or to sustain in society, and in the government of the country, that station to which your numbers and moral standing entitle you? If you have not, to what is it attributable? Your good sense and your patriotism are sufficiently known. It was to the mechanics of our country—of Boston—that we are perhaps indebted for the final adoption of the present Constitution of the United States. They met at the Green Dragon in Boston, in January, 1788, and recommended to the Convention of Massachusetts the adoption of the Constitution. It was Paul Revere, a brass founder of Boston, who carried these resolutions to Samuel Adams, who presented them to the Convention; and they tended much to induce that body of men to decide in

favor of the adoption of the Constitution. For the interesting circumstances which took place on that occasion, I beg leave to refer to a speech delivered by the great champion of our Constitution, Daniel Webster, at Pittsburg, two years ago this day.

On you, my friends, the preservation of that glorious Constitution, and the liberty we enjoy under it, may very much depend. What boots it that our fathers fought and toiled, and many of them fattened their native soil with their blood, if their descendants should not properly prize the blessings handed down by them? And how can we prize those blessings properly, if we will not use every means for increasing knowledge—intellectual light—among us? And why are you, mechanics, especially required to carry on this glorious work?—because, in doing so, you will be peculiarly advancing your own secular interests, whilst you will be better fitting yourselves to play your own parts, as constituent members of that government, a portion of whose sovereignty you are.

You have advantages, which, in early life, neither Rittenhouse, nor Oliver Evans, nor Fulton enjoyed. You have all the lights they have shed; and all the improvements by those who preceded and those who succeeded them, both in Europe and our own beloved land, are placed around and before you, and within your reach and power, to use and to improve, if you will.

It is astonishing the amount of information which one hour alone, out of the twenty-four, bestowed on the acquisition of useful knowledge, will bring forth. It is almost incredible, the amount of scientific works which a trifling contribution from each member of an association may bring together. There is no axiom truer than that "Time is Money"—nor than, that the heaviest taxes we pay, (as Dr. Franklin averred,) are those imposed upon us by our idleness, our pride, and our folly. The daily expense, which almost every one incurs, of a sixpence, for some matter of amusement or refreshment, which might just as well be dispensed with, would, if contributed by five hundred mechanics, and our town surely contains more than that number, produce over ten thousand dollars per annum. Yet such a tax imposed by government would be esteemed outrageously oppressive. One hour out of the twenty-four, now perhaps spent in conversation, perhaps in a beer house, or the bar room of a tavern, per chance, discussing politics, or the merits or demerits of some candidate for popular favor, in which neither side, in all probability, consults the best rules of courtesy, or the most conciliating means of persuasion, and each leaves his adversary just where he found him, or it may be yet more firmly wedded than ever to his own opinions—this hour per day, if spent in reading some improving work, or listening to a sound and sensible lecture on an interesting and appropriate topic, might enable you, in the course of a few years, to lay in a stock of valuable information, the benefit of which no one can calculate.

Can you, then, better close the labors of this grand Jubilee of Freedom, than in associating yourselves permanently together, as a Mechanics' Institute, and by your united efforts obtain a library suited to mechanical pursuits, and make provision for hearing, during a part of the year, letters from scientific men, on the various subjects connected with the sciences of Natural Philosophy and the Mechanic Arts?

The result will be that *reflection* will be induced. Your apprentices will be taught to *read* and *think*, and reading and thinking apprentices make intelligent journeymen, who in turn will make intelligent master workmen, fit to fill any station to which they may be called. An Athenæum or Reading Room is a much more fitting and improving school than some that are resorted to for spending evenings. This plan has generally been resorted to in our cities, with great approbation and unbroken success. And if the Mechanics' Celebration of Easton on the 4th of July, 1835, shall lead to a similar result here, then, indeed, may every citizen rejoice that it has been gotten up, and join in the aspiration that such an association may annually assemble on the anniversary of American Independence, and rationally celebrate the birth-day of Freedom, long as the sun holds his course, or the love of Liberty and Intelligence shall exist in the breasts of Americans.

[From the London Mechanics' Magazine.]

MARINE STEAM ENGINES.

Extracts from the Evidence given by Joshua Field, Esq. of the House of Messrs. Maudslays and Field, before the Select Committee on Steam Navigation to India.

693. You have had much experience in the manufacture of engines for steam vessels, have you not?—Yes, I have.

694. What do you consider the proper measurement and power of a steamer for a long sea voyage?—The relative proportion of power and tonnage fluctuates between two tons per horse power, and four tons per horse power, depending upon the purposes for which the vessel is intended, as well as the length of the voyage.

695. What do you say as to the measurement?—By measurement I understand tonnage. I have prepared a table which shows at one view the probable speed to be obtained by the application of engines of four different powers in vessels of the same tonnage, also the length of time for which they would be able to carry coal with each power on board. This table, if the committee desire it, I will put in.

An Approximate Table, showing at one view the Tonnage of Steam Vessels, with the Power usually applied to such Vessels, the number of Days' (of 24 hours) Coals they will carry, and the probable Speed per hour they will go with smaller powers and greater quantity of coal.

	10 miles.		9 miles.		8 miles.		7 miles.	
Tonnage.	Power.	Coal.	Power.	Coal.	Power.	Coal.	Power.	Coal.
252	100	5	80	6¾	60	8¾	40	12
290	100	6	80	7½	60	10	40	15
332	120	7	100	8¾	80	10½	60	14
375	120	8	100	9½	80	12	60	16
425	140	9	120	10½	100	12½	80	15¾
480	140	10	120	11½	100	14	80	16½
534	160	11	140	12½	120	14½	100	17½
597	160	12	140	13½	120	16	100	19
665	200	13	160	16	140	18½	120	21½
736	200	14	160	18½	140	20	120	23½
810	220	15	200	16½	160	20½	140	24
892	220	16	200	17½	160	22	140	26
980	240	17	220	18½	200	20½	160	25½
1073	240	18	220	19½	200	21½	160	27

696. Will you explain to the committee the object of this calculation; is it a comparison of tonnage with the consumption of coals and days, and the rates of going?—It is to show about how many days' fuel steam vessels will carry with larger and with smaller engines on board, as well as the average speed to be expected from each. Such a table can only be an approximation.

697. Will you first state what you consider the proper measurement and power of a steamer to go a long sea voyage?—I should recommend a vessel of from 7 to 800 tons, having an engine of 180 or 200 horse power.

698. How long would such a vessel run, and at what rate would she go?—She would carry coal for 14 or 15 days, and have a speed, in still water, of 9 or 10 miles per hour, and would realize in all weathers, at sea, an average of 8 miles while under-weigh.

699. What is the greatest proportion in tonnage and power for a steamer going a long voyage?—The greatest proportion of tonnage for vessels going long voyages may be stated at 4 tons per horse power; for short sea voyages, 3 tons per horse power; and for river vessels, as Margate or Gravesend, 2 tons per horse power.

700. What results does the power give to a vessel of the same tonnage with different powers as to the rate of going?—Great power in small vessels gives great speed, but they carry a small quantity of coal, and are soon exhausted, while larger vessels being able to carry a greater quantity of coals, work longer, and perform greater distances.

701. Then you draw this inference—the longer the voyage the less the speed?—The smaller the power, the greater capacity there is left for coal, and therefore the greater number of days' coal it would carry.

702. And the less speed?—And less speed having less power.

703. And the smaller proportion of power would of course consume less fuel in an equal time?—Exactly so.

704. Would not the greatest proportion of power consume the least fuel in equal distances?—Against winds or tides it is so; but in calms and fair winds it is not.

705. What is the greatest distance you suppose a sea-going steamer to run without changing?—The same steamer should not go more than 2,000 or 3,000 miles without a relay, or time to put the machinery in order.

706. Does that also include without

taking in coals?—A voyage of 2,000 or 3,000 miles may be performed in one stage, but it would be desirable on every account to divide it and take less coal.

707. What is the greatest distance she would go without coming to a station to take in fresh coals?—The distance is limited only by the quantity of coal she can carry.

708. What is the greatest distance you think a steamer could go without taking in fresh coal?—The greatest distance I have known a steamer to perform was the Enterprise, on her voyage to the Cape, in which she carried thirty-seven days' coal.

709. With continued steaming do you mean?—Yes; she steamed 34 days, and had three days' coal left.

710. Do you mean steaming day and night?—Yes.

711. Besides the coal, is it not necessary to give the engine rest?—It is; and the more frequently they can be stopped to clean and adjust, the better they will perform.

712. Then your observations must be supposed to apply to both?—Yes.

713. What is the comparison as to the duration between copper and iron boilers?—Copper boilers are found to last about seven years, without such repairs as render it necessary to take them out of the vessel, whilst iron boilers must be taken in four years.

714. Which would you prefer on the whole?—I should prefer copper for long sea voyages.

715. Is not the thickness of the metal an advantage in raising steam?—The metal is of the same thickness, whether the boiler be of copper or iron.

716. The salt water does not affect copper so much as it does iron, does it?—No, it does not.

717. What is your opinion of the relative advantage of the common paddle-wheel with that of any other invention with which you are acquainted?—The common simple paddle-wheel, when the dip does not exceed one sixth of the diameter, is an excellent propeller, and scarcely admits of improvement; but when vessels are so deeply loaded that the dip exceeds this in any great degree, a wheel with feathering boards will propel faster.

718. You have fitted river boats with vibrating cylinders, have you not?—Yes.

719. What may be considered to be their principal advantage over the other?—The advantage of vibrating cylinders in river boats is, that they are more simple in their construction, lighter, and occupy less space.

720. But in point of weight and space what is the advantage?—Reduction in weight is the most important consideration in river navigation.

721. Is not the power conveyed more immediately to the crank by the oscillating cylinder?—The power is more durable [directly?] communicated from the piston rod to the crank; the engines are, as it were, suspended to two strong beams, which lie across the gunwale, and project for the support of the wheels, forming an independent frame, in which the strain of the engine is confined; the whole resting on the upright sides, the weight is more equally distributed over the whole vessel; thus partial pressure on the bottom is avoided; this admits of the vessel's being of the lightest possible construction.

722. Is not the disadvantage, that it is very difficult to keep the connecting pipes steam tight in oscillating cylinders?—As we construct that part, there is not the least difficulty.

723. Has not that been found to be the case?—Speaking of those we have made, no such difficulty exists.

724. Must there not be continual wear on the connecting pipes, from the motion of the oscillating cylinder?—Not if they are properly constructed.

725. What is the largest power upon which you have constructed those cylinders?—Two thirty-fives is the largest we have made upon this construction, and that was for a sea vessel.

726. Would you think it advisable to make them of a larger power for sea-going steamers?—The principle is exactly the same in this as if on the ordinary construction; and so far as we have tried them, work just as well, and produce the same effect in speed, and economy of fuel, as our other engines.

727. What is the advantage of weight and space?—A reduction in the weight of the engine leaves greater capacity for cargo and fuel.

728. What is the extent of the improvement of weight and space?—About 10 per cent.

729. One fifth of the weight and one fifth of the space do you mean?—No; about one tenth of these.

730. Is not the pipe in the fixed cylinder, which brings the steam, connected with the cylinder by means of flanges, which are secured very tight together; and in the oscillating cylinder, must not the cylinder continually move on the end of the pipe, and is the chance of becoming less steam-tight greater in the oscillating cylinder than it is in the fixed cylinder?—No; the union is effected by a stuffing-box packed with hemp, and is kept perfectly tight without the least difficulty.

731. Is it more expensive than the other?—No, they are rather cheaper.

732. Would they not be apt to be deranged in a heavy rolling sea?—We have not found that to be the case: one has been working in a cargo vessel, between Dover and London, during the last winter to the present time.

733. What is the greatest extent of time that you have had oscillating cylinders at work?—About four years and a half or five years.

734. On the sea?—No; to Richmond.

735. That is a small high pressure, is it not?—No; it is a low pressure.

736. Have you had one on the sea for the last three years and a half?—No; only during the last year.

737. Was there not a second steam-boat with an oscillating cylinder going to Richmond?—There was one to Hammersmith last summer.

738. How did that succeed?—Very well, I believe.

739. The packet boat from Dover to Calais makes use of an engine of that kind, does it?—Yes.

740. Is that one of your manufacture?—No.

741. Is not the friction greater in the oscillating cylinder than it is in the fixed one?—No; as the number of bearings and moving parts are reduced, the friction should be reduced also, unless, indeed, it be badly constructed.

751. Have you considered the construction of the American steam raft?—I have seen a description of it.

752. Do you think highly of it?—It is certainly an ingenious method of obtaining great speed in smooth water, but its application is limited.

753. What do you think of the practicability of applying it generally?—It would not do at sea; and as it must draw more water than a single vessel, it would not do for shallow rivers.

754. The speed of it is very great, is it not?—It is so stated, and I believe it may be so, for the following reasons: the two pointed cylinders, from their form, may be made of the lightest materials, and need not be made of larger diameter than is sufficient to displace the total weight; their form offers the least resistance, and their relative position gives the required stability.

755. What do you think is the best kind of coal for steam vessels, with respect to power and safety from spontaneous ignition?—Hartley, Elgin, Inverkeithing, Ward's Llanelly, Llangennech, and Lydney, are all esteemed good coals, and are free from the danger of spontaneous ignition.

756. What is that Scotch coal?—The three first named are Scotch coal.

757. How is the Welsh coal, do you consider, upon those points?—The Welsh coal produces very great heat, and is very effective; but the heat being confined to the fireplace more than other coal, it destroys that part of the boiler faster than the Scotch coal. The heat is more intense in the fireplace, and less is carried forward to the flues than by the other coal.

758. What is the comparison of the proportion of the Scotch coal to the English coal in its power?—I think they are much the same. We have made many experiments, and we do not find much difference.

759. The Welsh coal is considerably greater, is it?—I do not think it is. It has the advantage of not smoking.

760. Is not that because every part of the coal is consumed?—Yes.

761. No portion is carried off, must it not therefore be a coal of greater intensity in a given bulk on that account?—I cannot state that it is more powerful, or more economical, but the heat is more intense in the fireplaces.

762. Must it not therefore be a coal

of greater intensity of heat than if a portion of it were carried off?—It is not so productive in the flues. It does not carry its heat forward, it is more like the fire of a forge.

763. Then, including the expense and power, you would give a decided preference to one species of coal rather than another?—I prefer the Scotch coal.

764. On what account?—I think it injures the boilers less, and leaves less residuum.

765. What species of Welsh coal do you allude to?—Llangennech and Ward's Llanelly are Welsh coal, and are without smoke.

766. Under what circumstances does spontaneous ignition occur?—Coals which contain iron pyrites, and have become damp, are most liable to ignite.

767. What do you think of the Forest of Dean coal?—Some of the Lydney coal which we tried proved very good.

768. Do you ever use the Kilkenny coal?—No.

769. At what should you estimate the expense of such a vessel as you consider best calculated for a long sea voyage?—A vessel of 800 tons, and 200 horse power, would cost about £33,000, fitted out in the best manner, with engine and every equipment.

770. Then such a vessel as you stated at first, is that the one that you prefer?—Yes.

771. What would be the prime cost, and what the annual expense of such a vessel?—The prime cost would be about £33,000.

772. And what the annual expense?—Do you propose to include the repairs with the expenses of working?

773. Working and every thing else—keeping her up, and every thing.—How many days do you propose her to work in the year?

774. Every thing that is to keep the vessel going for as many days as she shall continue, to the end?—The annual cost of working such a vessel, including coal for steaming one third of the time, and all other expenses, would be about £7,000.

775. In computing the entire expense of a steam vessel, and annual charge, what amount should you say for capital, the sum for insurance, repairs and renewals, calculated to create the perpetuity of the property?—I think that would not be less than 25 per cent. upon the outlay.

791. By which means could you go the greatest distance, without being obliged to take in coals; by the working a small power, and at a slow rate, or by working with a great power, at a rapid rate: for instance, an engine of 100 horse power, working at ten miles per hour, or an engine of 40 horse power, working at 7 miles per hour?—In moderate weather the small power with a great quantity of coal; but against head winds a great power will go the greatest distance.

792. In the construction of a river steamer, do you prefer the flat bottom, with the raking bows, and a parabolic curve?—I think for river steamers, where the draught of water is not very limited, the form of the vessels adopted on our river to Gravesend, or Margate, are best for speed, they are sharp, dividing the water sideways; but, perhaps, in a very shallow river, the spoon-shaped bow might be best. I do not know any experiment that would directly set that matter at rest; there are different opinions upon it.

793. What construction do you think the best for steering a vessel round a point against a strong current?—I should think the sharp vessel would steer better than the spoon-shaped vessel.

807. Would it be safe and desirable to use a high pressure engine in a small vessel on a river, in order to lighten her draught?—I am not acquainted with any high pressure engine that has been quite successful in a boat yet; all the high pressure engines that I have seen are as heavy as the low pressure engines, except in some few instances of a particular kind, which are not fit for general navigation.

808. How is it on the score of safety?—The low pressure engine is, of course, much safer.

813. What do you consider to be the comparative advantage of steam navigation in seas and rivers, as to its expense, and as to its certainty?—I can speak of the certainty better than the expense; the rate is increased more than double and the time halved. I have also an abstract of sixteen voyages made between Falmouth and Corfu by sailing vessels, the

mail packets, before steam packets were established; it is the same voyage, and the average is 93 days, the steam packets giving an average of 47, which is half the time.

814. What is your opinion of the comparative advantage of the navigation in rivers and by sea in steamers, as to expense and certainty?—River navigation is less expensive, inasmuch as smaller vessels will suffice, and river voyages are performed with more certainty.

815. Suppose it were one thousand miles by river, and one thousand miles by sea, on which side is the advantage, both as to expense and certainty, both by steam?—River, certainly.

816. Suppose you have a whole space of 3,000 miles to pass by water, half of which is in one case to be performed by the river, and in the other the whole by sea, which of the two should you think preferable as to expense and certainty; which should you prefer as a permanent navigation?—Two kinds of vessels being necessary in this case, I cannot speak confidently.

817. Which should you prefer as to certainty?—I should think the certainty much the same in both cases.

818. Should you think a sea navigation as certain as a river navigation?—The Mediterranean packets show it to be very certain, for the fluctuation is only a very few days, which is very little for the whole four years.

819. On which side should you think the speed would be in favor, of the sea or the river, supposing there was a current of 3 miles in the river, and that you had 1,000 miles to go against that current, or 1,000 miles to go by sea, by which, by the river or by the sea, on an average, would you pass over in the shortest space of time?—I rather apprehend the sea.

825. You have given your opinion as to the proportionate power of tonnage to sea-going steamers: on what data do you found that opinion?—From having fitted out a great many vessels.

826. Do you mean vessels employed in the service of Government, or do you mean vessels employed for private purposes?—Both.

827. What number of persons in proportion to the register of tonnage of the steam vessel would you allow for short voyages, and what for longer?—How many it would be safe or convenient?

828. No; how many men would you wish to take to man your vessel, that is, the crew?—I think about one man to every thirty tons, including the stoker.

829. What would be the proportion of passengers, or soldiers, if you were conveying troops?—About one man to a ton, I should think, or more for a short distance.

830. You have given us the quantity of fuel of every horse power, have you not?—Yes, I have.

831. What quantity of fuel, and what description do you allow per horse power per hour?—We allow eight pounds per horse power per hour.

832. And what is that calculation founded upon; is it founded upon the average of the consumption?—Upon the consumption, and upon experiments made at different periods with engines of our manufacture.

833. What sized cylinder, and what length of stroke, do you allow for 180 horse?—Two cylinders of 51½ inches, and 4 feet 6 stroke.

834. What would you allow for a 200 horse power?—Two cylinders 53 inches diameter, and 5 feet stroke.

835. What would you allow for a 250?—Two cylinders, 59 inches diameter, 5 feet 6 inches stroke.

836. What would you allow for a 300 horse power?—Two cylinders, 64 inches diameter, 6 feet stroke.

837. What pressure do you use in the boiler?—About four pounds.

838. And what in the cylinder?—As near the same as an open pipe will receive it.

839. And what proportion is the paddle wheel to be to the length of the stroke?—From four to five times the length of the stroke.

840. What breadth of float would you recommend?—For river navigation, the wider it is the better; for sea navigation, about one third the diameter of the wheel.

841. What length of time would an engine work without injury?—In one spell do you mean?

842. Yes.—They are frequently worked from Falmouth to Gibraltar, which is 1,100 miles, in one spell.

843. What is the greatest and the shortest length of time they take to do

that distance; that is, a spell of 1,000 miles?—Eight is about the shortest, and 12 the longest.

844. How long should an engine last if well managed, without repairs?—About from 4 to 5 years.

845. What parts of the engine and boilers are most liable to accidents?—Those parts most exposed, such as the wheels; then the moving parts, cross heads, beams, &c.

846. Can duplicates of those parts be kept on board?—Yes.

847. Does it require any more engineers to manage an engine of 300 horse power, than it does to manage one of 100 horse power?—It does, but not in proportion to the increase of power.

848. In proportion to the power, is a large engine more economical than a small one?—Yes, it is rather.

849. Does it consume less coal in the same proportion?—It consumes less coal in proportion as the power increases.

850. Suppose a vessel to have 300 horse power in smooth water, or a fair wind, could you work it at the same consumption of fuel which a vessel of 200 horse power would be worked at, by throttling the valves, wire-drawing the steam, or any other mode of working the engines?—Yes, you may do so.

877. Have you ever made experiments on the combustion of wood, for the purpose of raising steam?—I have not myself made those experiments, but I am aware that such have been made.

878. Are you sufficiently acquainted with the subject to give an answer as to the proportion of space alone that a day's consumption of wood would bear to a day's consumption of coal?—I can only state generally, that it requires three times the weight of wood to produce the same effect as coal.

885. You were speaking of the comparative advantages of river and sea navigation; would not the boilers last longer by supplying them always with fresh water?—They would, and that would be an advantage in favor of the river.

886. Are you aware of the improvement introduced into some steam vessels, to condense the steam in the pipes, without admitting the jet of water into the aperture?—I am.

887. If this were adopted and found efficacious, you would not use the salt water at all, neither for condensing nor for the boilers, would you?—No, I should not.

888. Do you think it likely that this will be brought to perfection?—I do not know; if it succeeds it will be a very great advantage.

889. Is the salt water more or less injurious to copper or to iron?—It is much less injurious to copper than to iron.

890. Is it in comparison with fresh water?—Yes.

891. If that plan which is now trying be carried into execution, will that diminish the burthen of the engine *itself* in the vessel?—No, it rather increases it; but it promises to reduce the quantity of coal.

892. That you find to be one of the effects to arise from the improvement, do you?—Yes, I think that would follow.

893. It would get rid of the condenser, would it?—No, it requires a larger condenser.

894. You mentioned that, as applied to sea voyages, copper would last about seven years, whereas iron would last only about four years; what would be the proportion in fresh water?—In fresh water, for steam navigation, the boilers last about seven years.

895. The iron boilers are you speaking of?—Yes; copper boilers are not used in fresh water; there is no inducement to use copper boilers in fresh water, because iron lasts so long.

896. Are copper boilers used in salt water?—Yes.

898. In preferring copper boilers to iron ones for salt water, do you make an allowance for the difference of the tensity in copper, and the different temperature in the boiler; that copper diminishes in tensity as heat is applied, and iron does not?—We find no difference in that respect; the copper and the iron are of the same thickness, and the question turns entirely upon their durability.

New Method of applying Carbonic Acid to the Soil as Manure.

To the Editor, &c.

Dear Sir,—I send you a short account of the method I have used to apply carbonic acid to the soil as manure. If you think the subject of sufficient im-

Fig. 2.

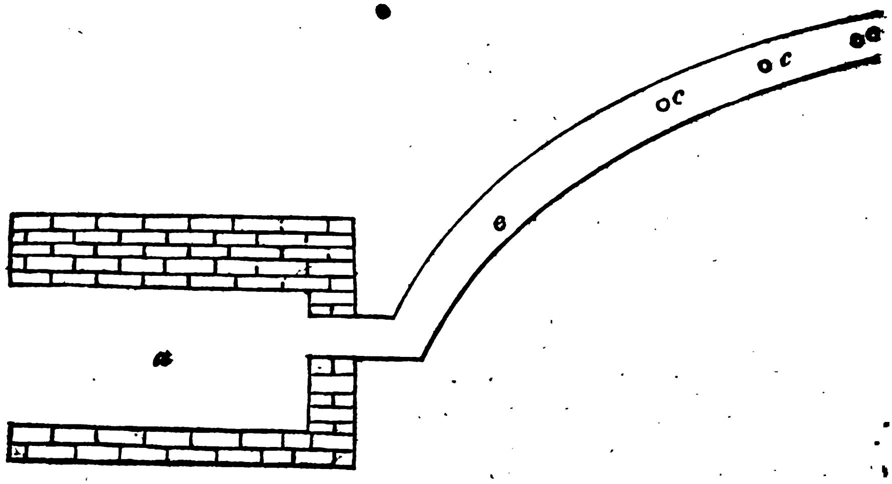
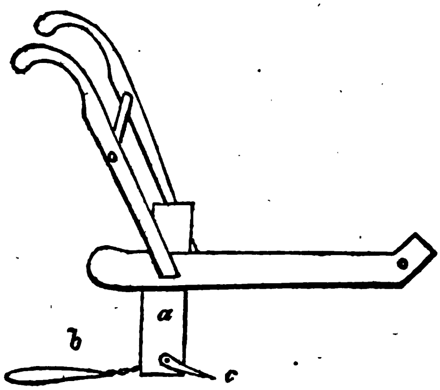


Fig. 1.



portance, you will probably confer a benefit on our country by giving it a place in your useful journal.

Fig. 1 shows the construction of the plough with which the holes are made : *a*, the blade ; *c*, the point ; *b*, the rod, which opens the holes.

Fig. 2 is a vertical section of the furnace, and a small part of the flue : *d*, the furnace, or place where the wood is burnt ; *e*, the flue ; *c c*, &c. the holes made by the plough.

In the combustion of wood or coal, a large quantity of carbonic acid gas is produced, which is known to act as a fertilizer, whether applied to the leaves or roots of plants. From the trials I have made with it, I am satisfied it can be applied to the soil with less labor and expense than any other kind of manure.

Its application is simple and easy. It is only to convey the smoke from a furnace into the soil, through holes a few inches under the surface of the ground. These holes are made with a plough, something like a common coulter, only the blade is thinner. A round rod, about a foot long, and an inch and a half in diameter, is fastened by a small short chain to the lower part of the blade, and follows exactly in the track of the point, opening a round smooth hole. See fig. 1.

The field intended to be fertilized is run off with this plough the distance the rows should be apart, so that a hole shall be under each row. A ditch is then cut across the rows so as to intersect all the holes, and when covered serves as a flue or chimney to carry the gas from the furnace to the small holes, and through them to every part of the field, where it permeates ; the soil is absorbed by its moisture, and finally taken up by the roots of the plants.

It is obvious that the furnace should be situated at the lowest part of the flue, to give it draught. See fig. 2.

There are other important results to be

gained by the use of this contrivance besides the fertility it imparts to the soil. It gives a hot-bed on a large scale, with its heat completely under control. Nearly all the heat generated in the furnace is deposited in the soil; by its aid the dominion of plants may be extended farther north. Cotton can probably be raised in New-England; and sugar cane in all the country which now produces cotton.

It is probable that other gases may be used with advantage, especially carburetted hydrogen, which is easily and cheaply produced by burning wood in a smouldering furnace. Yours respectfully,

R. S. THOMAS.

Richmond Court House, N. C., July 28, 1835.

The foregoing has, we believe, entire originality in its favor, and not only shows a mind capable of traversing untrodden ground, but not destitute of science to guide it. His plan, though certainly correct in principle, is one of those which, though extremely plausible, we think could not be decided on with certainty by reasoning *a priori*, and which consequently requires the test of experience. But Mr. T. speaks as having so tested, and we certainly see no reason to doubt. If some difficulty which we do not foresee should not be found in the practice, we should think it one of the most valuable improvements ever made in the science and practice of agriculture, and still more so in horticulture.

[From the London Mechanics' Magazine.]

Mr. Woodhouse's Angular Railway Bars.

Sir,—As the form of rails best suited for affording safety, economy, durability, &c. has occupied the attention of many scientific persons, and formed the subject of several communications in your pages, I hope, without presumption, I may be permitted to propose the annexed as a plan, in my humble estimation, calculated to effect these objects.

Some few months since, I proposed the use of an angular rail; my plan was not then matured, but as I have since given some little attention to the subject, I send you the results.

The purpose of giving an angular shape to the rail is, that the engine wheel (also having an angular grooved rim to correspond) may have a greater hold upon the rail, thereby giving greater efficiency to the power of the machine, preventing an irregular action, which must be produced when the wheel slips on the rail (a circumstance much alluded to at the opening of the Selby Railway,) and thereby much strain to the machinery. The top surface, one inch broad, is intended for the train-wheels, and where friction would be a defect, it is thereby avoided. The form of the rail is intended to admit of being reversed at any future time when the upper surface is worn. The chair is not intended to be fixed, but the central part, which projects downwards, is to let into the stone sleeper, and be bedded in with cement or not, as found best. The rail is not fixed to all the chairs, but only to the centre one; which proposition I made with another plan of Rail and Chair sent to the *London and Birmingham* Railway Directors. The size of the present rail is as follows: Depth, $4\frac{1}{4}$ inches; extreme width, $2\frac{1}{4}$ inches; surface, 1 inch; angles, from 15 to 25°, as the friction is required; the calculated weight is rather more than 51 lbs., but upon shrinking, it would probably not be more than 50 lbs. to the lineal yard.

Fig. 1.

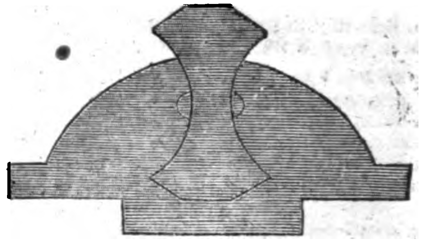
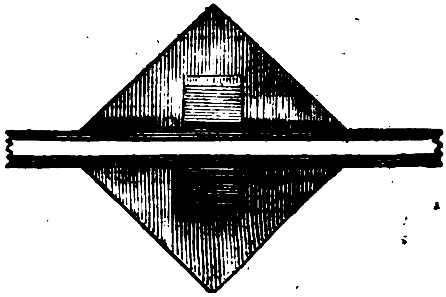


Fig. 2.



It has been objected to turning the rail when one side is partially worn down, that in proportion as it is so worn, its strength must be diminished. But as long as the internal structure of the rail is not so permanently injured as to prevent its return after deflexion to its original horizontal

form, it seems to me that it must be nearly, if not to the full, as efficient as ever.

As respects the supporting of the rails, I also proposed that instead of having the rail resting solely upon the chair, the chair should be so planned that the rail should also rest upon the surface of the stone, whereby it would be strengthened, and the stone, by receiving a steady vertical pressure, would be rendered less liable to the casualties so frequently complained of.

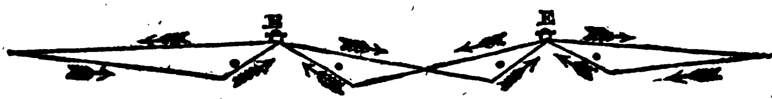
I also proposed that the stone-block or sleeper should be placed in an angular direction with the length of rail or line of road, whereby a greater surface of stone would be placed in the directions most required, viz. lengthways and sideways. By this plan an 18 inch stone exposes a surface of 2 feet and more to the pressure.

Fig. 1 is a section of the rail as it rests in the chair, which, when the lower portion of the chair is let into the stone, will rest upon the stone also; the two small sections are for the purpose of fixing the centre of each rail to its chair. Fig. 2 is a vertical view, showing the angular position of the stone upon a smaller scale.

I am, Sir, yours respectfully,

P. WOODHOUSE.

Kilburn, May 27, 1835.



[From the London Mechanics' Magazine.]

Quick and Cheap Mode of Railway Transit without Locomotive Engines.

Mr. Editor,—A great deal has been said on both sides for and against the undulating railway principle, but hitherto no satisfactory practical results have been obtained on which to found a definitive judgment respecting it; and although the shareholders of the Liverpool and Manchester Railway are deriving considerable profits, owing to the immense traffic between the two towns, still there are doubts if many other roads will pay at all: the expense of locomotive engines being so great, wherever there are considerable inclines to be overcome, and the first expense of constructing the railway so enormous, from the endeavors made by tunnelling and embanking to reduce that expense. I am, therefore, induced to send you a new plan of an undulating railway, by which locomotive engines (except on very rare occasions, indeed,) will be dispensed with; the trains will travel by the force of their own gravity from station to station, as described in the above diagram.

E E are stationary steam-engines, and O O O O inclined planes by which the stationary engines bring the trains up to a level, when the trains, going and returning, take the roads the arrows point to. I have no doubt but in many situations falls may be obtained each way for miles together. Deep cutting and tunnelling would be thus, in a great measure, dispensed with; and if tunnels in some situations were absolutely necessary, by giving them the required falls for the trains to go through them, by gravity alone, travelling through them would not be disagreeable, as no engine would go with the trains.

I am, Sir, your obedient servant,

THOMAS DEAKIN.

Blaenavon Iron-Works, June 5, 1835.

Abstract of the Specification of a Patent for a mode of manufacturing Wrought Nails, Tacks, or Spikes, by first preparing the material, rod, or pieces, from which they are to be made, in such a manner as greatly to facilitate the process of making them, and then operating upon the pieces so prepared by means of a machine particularly adapted to that purpose. Granted to WILLIAM C. GRIMES, *York, York county, Pennsylvania, December* 17*th*, 1834.

The metal is first to be rolled or slit into rods, but not of the exact size and form of the body of the nail to be made, but they are to be broader one way, and thinner the other, the rods being usually about twice as broad as they are thick; the width and thickness of the rod, or piece, however, being such that, when it is staved, swaged, or compressed upon its sides, or edges, enough to bring it into a square form, it shall then be of the requisite thickness for the body of the nail, tack, or spike. The rod is to be cut off into the proper lengths for the nails, tacks, or spikes; they are to be cut square off at one end, the other being cut very obliquely across the rod, thus giving the requisite taper for form-

ing the point to the nail, &c., which taper will be greater, or less, according to the obliquity of the cut across the rod. The nails, tacks, or spikes, so prepared, may be finished by various methods, as by forging, swaging, or compression; and the machinery to operate upon either of these principles, to effect the same end, is susceptible of an almost endless variety of modifications.

The machines that I have adopted for the purpose are made to operate upon the principles of swaging and compression, and are constructed as follows. The prepared piece is let or dropped into the upper end of an angular trough, or gutter, which stands inclined from a vertical line about thirty degrees, (more or less.) The trough consists of two flat sides, joined at right angles, the angular point being downwards, so that, if the trough was placed in a horizontal position, its sides would rise at an angle of forty-five degrees from the horizon; the piece that forms this trough, or gutter, is the ridge, or rather one corner, of a triangular frame. Swages, or hammers, strike or act upon different sides of the nail as it descends along this trough, or gutter; these swages are placed in pairs, each pair striking upon the nail within the trough alternately, and consequently upon its different sides; their helves, at their outward ends, are jointed to the two lower angles of the frame, and in such position that they operate at right angles with each other.

The piece for the nail, &c., when dropped into the gutter, slides down to a moveable piece, or stop, that rises through the bottom of the trough, which arrests it for a moment, or until both swages have operated, when this stop recedes, and the piece instantly slides down until it is arrested by a similar stop, and is again struck by two other swages, and so on through any required number; three pair will, I apprehend, be sufficient in all cases. The last pair of swages, which are at the lower end of the trough, or gutter, fall upon, and gripe the nail, while a heavy hammer, from below, strikes upon and heads the same. The heading hammer, swages, and stops, all receive their motion from cams fixed upon a revolving shaft, running up through the triangular frame. Two or more nails may be passing down the angular trough at the same time, as the stops, after allowing a nail to pass, immediately resume their position. The swages, hammer, &c., after being raised by the cams, are forced back upon the nail by suitable springs.

I intend sometimes to form or finish the nails by pressure, which is effected in the following, or in a similar, manner. The machine, when intended to finish the nail by pressure, is to be made, generally, like the preceding machine, but the triangular frame will be much shorter, as there will be the lower pair of swages only, the inclined trough, or gutter, having a single stop. The action upon the nail, &c., is to be very similar to that before described, being alternate, and upon different sides, but it is to remain in the same place till finished. After a few reciprocating or alternating motions of the jaws, one or both of them close or press upon the nail, and hold it whilst there is a head pressed upon it. In forming some nails, the alternating motion of the jaws may be unnecessary, as they may close upon the nail at once, and form it sufficiently by this single pressure.

There should be two pairs of shears for cutting off the rod, whether it is cut hot or cold; the cutting edges of these stand at right angles, or nearly so, but both pairs may be fixed upon short arms, standing out from a strong vibrating, or semi-revolving, shaft; one pair to cut the rod off obliquely, and the other pair to cut it square. The two troughs, spouts, or gutters, into which the nails fall from the respective shears, may both lead to the same point, and terminate in one groove, or gutter, before it reaches the machine below.

I intend sometimes to cut the pieces for the nail from plates, instead of from rods. The plate should be of sound material, and rolled much broader than other nail plates. These plates are to be cut off transversely into pieces about two-thirds the length of two nails; from the sides or edges of these plates, the pieces for the nails are to be cut. The plate is to be held and turned over at each cut, in the manner followed in making cut nails, the length of nail, however, being only about two-thirds of the width of the

plate; the shears being bent into such form as to run off to the edge of the plate; the piece thus cut off is brought to an acute point, being tapered less than half its length; the taper, or points, of the nails overlapping each other in the plate. This plate should be at a red heat when the nails are cut from it, if they are to pass directly into the machine; or they may be cut off cold, and afterwards heated and fed to the machine, as before specified.

What I claim as new, and as my invention, in the before described mode of preparing the pieces, or material, for wrought nails, and in the machine for finishing them, and for which I ask letters patent, is—1st, The cutting the rod obliquely, in the way described, to form in part, or wholly, the taper of the nail, tack, or spike, whereby mere pressure, or swaging, will suffice to finish the nail, &c.: the rods being broader one way, and thinner the other, than the body of the intended nail.

2d, I claim the manner of preparing the pieces for wrought nails, tacks, &c., to be finished in my machine, by cutting them out of plates of metal, as herein before shown. I do not claim the cutting with the grain of the metal generally, that having been previously done, but confine myself to the cutting into the form, and for the purpose, described. I claim the forming or finishing nails, tacks, or spikes, or other metallic articles, by swaging in, or as they descend an inclined trough, or gutter, after the manner, or upon the principle, herein before specified.

3d, I claim the finishing of nails, or similar articles, after being prepared as herein before shown, by alternate or simultaneous pressure, after the manner, or upon the principle, before specified.

William C. Grimes.

Abstract of the Specification of a Patent for a Mode or Machine for making Wrought Nails, Tacks, or Spikes. Granted to Wm. C. Grimes, *York, York county, Penn., Dec.* 17th, 1834.

To make wrought nails by machinery is an object that has been sought by numerous individuals; hence it may be useful, in order to point out more clearly the novelty in the present plan, to refer to the general principles upon which preceding machines, or processes for that purpose, have been founded.

One of the first, and it is believed, an almost universal principle, that has been observed in previous attempts to make wrought nails, has been to make them from rods that were rolled or slit to the size of the larger part of the body of the nail. To taper, or to give to the nail its requisite form, from such rods, various modes have been essayed; swaging, forging, and rolling, have been tried, but the latter by far the most generally. Modifications of these principles, to effect the object proposed, have been too numerous to be here detailed. But whatever has been the modification of the machine, it has generally embraced or been constructed to operate upon only one of these principles. The novelty of the present machine consists in its being constructed so as to combine several of these principles at the same time, viz. cutting, swaging, or pressing, and forging, or percussion, and to make the novelty more apparent, the nails, &c. are not to be made from rods of the size of the body of the nail, but from broad plates, and these at a red heat. These plates are to be prepared by rolling, after the manner of plates for cut nails, but with this difference—they must be of perfectly sound iron, and two or three times as broad as the length of the intended nail, but of about the same thickness. These plates are to be cut off transversely into pieces, about two-thirds the length of two nails. From the sides of these pieces, or plates, the nails are to be formed and cut, the length of the nail running with the grain of the iron, or parallel with the length of the original plate. These plates are held, turned over, and the nails cut from the sides or ends of them, in the same manner as is practised in making cut nails, but with this difference—in making cut nails, the plate is either cold, or at what is called a black heat, whilst in my process the plates are to be at a high red heat. In making cut nails, they are cut off with a regular taper from end to end; in this process they are tapered not more than half their length. In making cut nails, the width of the plate is the length of the nail; in this process the plate is cut into lengths transversely, which

length forms two nails, by their points overlapping each other. In making cut nails, the first action upon the nail is to sever it from the plate; in this process the nail is nearly formed before it is severed from the plate.

As the plates are cut at a high red heat, they would soon destroy the temper of the steel cutters or dies, if continually applied, as in making cut nails; therefore, to prevent such injury, I cut a few nails in rapid succession, and then allow a short intermission, when the plate is withdrawn, and a jet of water is applied for an instant to the dies, which continue in motion, the plate and the jet of water being applied alternately to the dies.

Two or more of these plates should be in the fire at a time, as only a part of one plate can be cut or formed into nails without re-heating. The plates may be changed in the furnace during the time that the jet of water is let on to the dies.

The water in the pipe that conducts it to the dies should be under considerable head, or pressure, and the starting and stopping the jet may be done in various ways; the valves or cocks may be opened at regular intervals by the machinery, or a treadle may be applied for that purpose.

When the nail is to be formed and cut from the plate, such a portion of the latter as shall be necessary is placed between the jaws or dies, constructed for the purpose, and which are parallel with the end or edge of the plate, for about half or two-thirds of the length of the nail. The remainder of the dies are turned off at a slight angle, running out to the edge of the plate, thus forming the taper or point of the nail; the plate is then turned over, and its opposite side brought into the same position between the jaws, and another nail is cut, the point of which commences at the same point in the plate that the taper began in the preceding nail.

A heavy hammer for striking a head upon the nail is placed in front of the end of the jaws; this hammer is fixed upon the end of an upright rod, or helve, the lower end of which is fixed to a horizontal shaft, furnished with round tenons, or gudgeons, that work in suitable boxes on each side of the frame of the machine. From the side of this shaft, an arm projects, being inclined downwards; this arm may be about one-third of the length of the said helve. A beam or lever, whose fulcrum is near its centre, lies nearly in a horizontal position, with one end beneath the fly-wheel, and the other above the said short arm, to which it is jointed by a link. A cam on the periphery of the fly-wheel acts upon the end of this lever, or beam, the latter being gradually borne down by it, while the opposite end of the beam rises, and by its aforesaid connection with the hammer, the latter is thrown back to a proper distance; the said cam then terminates abruptly, and by a strong spring the hammer is brought forcibly upon the iron which is to form the head of the nail.

I intend sometimes to form the head upon the nail by pressure, instead of percussion.

Any competent power may be employed to impel the machine.

Machines greatly differing in form, and in the particular arrangement of the respective parts, may be constructed upon the preceding principle to produce similar results, or effect the same end by similar means. I therefore do not intend to limit myself to the particular arrangement herein specified, but to change such form and arrangement as I may think proper, while the principle remains unchanged.

What I claim as new, and as my invention, and for which I ask letters patent, is, 1st. The making or forming wrought nails, tacks, or spikes, from or upon the edges or sides of metallic plates, by pressure and cutting, after the manner, or upon the principle, herein specified.

2d. The manner of severing the plate from the nail, so that a part of the latter is left standing out beyond the end of the jaws as herein before described.

3d. The side jaw by which the plate is gauged, and the nail compressed, and removed from the jaws.

4th. I also claim the general construction and combination of the respective parts of the above described machine, by which general combination it derives that character by which any competent machinist will readily distinguish it from any of the various nail machines heretofore in use.

But I do not claim as my invention the fly-wheel, cams, levers, or any other

part of the machine, taken separately and individually; but, as aforesaid, the combination of these parts upon the principle herein fully set forth. Nor do I claim the forming of nails from nail plates, by cutting them with the grain, that having been already done; but in this particular I confine myself to the peculiar manner in which the cutting is effected. WILLIAM C. GRIMES.

[From the London Repertory of Patent Inventions, &c.]

EXPERIMENTS ON THE PRESERVATION OF SHEET-IRON FROM RUST, IN INDIA. BY JAMES PRINSEP, ESQ.—The proposed extensive employment of iron steam-boats, for the navigation of the Ganges, rendered it a desideratum to ascertain what varnish or composition would best preserve the exterior surface of such vessels from the rapid corrosion to which iron is so peculiarly subject in a hot climate. A series of experiments was undertaken with this view by myself, at the requisition of government; and it may perhaps be useful to record the principal results in a journal of science.

Two sets of six wrought-iron plates, each measuring 3 feet by 2 feet, were fixed to two iron triangles, the plates being prevented by studs from coming into contact with each other. The same varnishes were applied to both sets, one being intended for entire submersion under water, the other to be only half immerged, in order to [that it might] feel the united influence of air and water.

The following were the coatings applied:

1. Common coal-tar laid on hot, and the plate heated.
2. *Thetsee* varnish of Ava, one coat. This took a very considerable time (two months) to dry, kept first in a cool room, and afterwards in a room heated by furnaces.*
3. Native *Dhuna*, applied to the iron hot, in a thick uneven coat.
4. Best white-lead paint, three coats; allowed to dry and harden for nearly three months.
5. Coachmakers' varnish, two coats; dried rapidly.
6. Spirit varnish, several coats; warmed.
7. White wax, melted on the surface.
8. White wash, of pure lime water.
9. The surface of the iron plate cleaned and guarded with an edging of zinc, soldered on.
10. The natural surface of the rolled iron sheets, covered with its usual hardened grey oxide.

Many of the foregoing were employed from curiosity only, especially No. 6, the spirit varnish, which had, on many occasions, proved quite ineffectual in preserving the surface of polished iron and steel from rust in the atmosphere of Calcutta.

The two frames were suspended as above described, one under water, the other half immersed, from one of the unused dredging boats, near the Chitpur lock gates, in the circular canal, where they were left undisturbed for three months, during a period of the year when the water of the canal was only slightly salt.

They were then taken up for examination, and presented the following appearances.

Plates under water.	Plates half above water.
1. Tar—Perfectly preserved and free from rust.	1. Tar—A few dots of rust between wind and water.
2. Thetsee — Perfectly uninjured in appearance.	2. Thetsee—A line of rust at the level of the water.
3. Dhuna—White and pulverulent; soft and easily rubbed off while wet: rust here and there.	3. Dhuna—Large cracks from the contraction of the part exposed to the sun, whitened where thick, black where thin; plate preserved above water.
4. Paint—Almost wholly disappeared, and blotches of rust on the surface.	4. Paint—Paint uninjured above water mark, and plate preserved, but below water entirely removed.
5. Copal varnish—Whitened, pulverulent, and soft; but not much oxidated.	5. Copal varnish—In air less whitened, spots of rust breaking out every where.
6. Spirit varnish—Whitened and very rusty.	6. Spirit varnish—Very much corroded.
7. Wax—No trace of wax left, and very rusty.	7. Wax—This plate was all under water.
8. Lime—Flaky, peeled off, and very much corroded.	8. Lime—In air remains on and acts pretty well.
9. Zinc—The clean iron excessively corroded and bad: the zinc also oxidated.	9. Zinc—Much more rusty in the air than under water, where a kind of crust was formed.
10. None—The natural surface was a little whitened, and pretty well preserved.	10. None—Rusty on the edges, or where it had been scraped; elsewhere little injured.

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* Major Burney states, that three or four days are sufficient for the varnish to dry when laid on wood (Journal, vol. i. p. 172). I had not a damp vault in which to expose the plate as recommended by that officer, and that may partly account for the delay in drying; but all varnish and paint takes longer to dry on metal than on wood, from its non-absorbent nature.

The superior preservative power of coal-tar to all the substances tried, with the exception perhaps of the thetsee, was evident; the Burmese varnish labored under the disadvantage of being a single coat, otherwise it would, doubtless, from its hardness, its firm adherence, and its inalterability by water, prove fully equal as a lacquer to the coal-tar: the latter has, on the other hand, the advantage of drying and hardening as soon as laid on.

The change effected on the resinous varnishes is produced by an actual chemical combination with the water; the soft pulverulent matter is analogous to the white powder obtained by the addition of water to an alcoholic, or to an acid solution of resin.

The failure of the zinc guard, which was expected to act as an electro-positive protector to the iron, may, I think, be attributed to its being adulterated with lead, which being negative with respect to iron, would cause, as was actually the case, a more rapid oxidation of the latter metal: (the impurity of the zinc was afterwards fully proved.)

The wax and the white paint had entirely disappeared from the surface of the metal under water, before the plates were taken up; it is impossible, therefore, to say in what way their removal was effected.

The bituminous (coal-tar) coating was finally adopted, and it has been successfully applied to the iron steamer, the Lord William Bentinck, lately launched under Captain Johnston's superintendence.—[Journal of the Asiatic Society of Bengal.]

Chemical Examination of the Petroleum of Rangoon.—By Robt. Christison, M. D., F. R. S. E., Professor of Materia Medica in the University of Edinburgh, &c.—At the close of the preceding session, the Council of the Society did me the honor of entrusting me with the chemical examination of several articles sent not long ago to the Society by Mr. Swinton, Secretary to the Government at Calcutta. The articles in question are, 1, Specimens of the *black varnish* used in different parts of Hindostan and the Burmese territories, with specimens of the juices of which these varnishes are said to be compounded. 2, Specimens of *naptha* from Persia, and of *petroleum* from Rangoon. 3, Specimens of *wood-oil*, a variety of fluid turpentine. 4, Specimens of crude *caoutchouc*, and of solutions of it in wood-oil.

The only one of these articles which has hitherto yielded results of such interest as to induce me to lay them before the Society, is the petroleum of Rangoon, which appears to contain a compound inflammable principle hitherto unknown.

The petroleum of Rangoon, termed by Mr. Swinton earth-oil, and more generally in the East, ground-oil, is probably the same with what may be procured in various parts of our eastern dominions, by merely digging a few feet into the soil. In the vicinity of Rangoon it may be obtained in immense quantity for the mere trouble of digging it. It is used in Hindostan as pitch for all manner of wood-work; and is likewise a favorite external remedy for rheumatism, being employed for that purpose in the way of friction.

I am not aware that either this, or any of the European petroleums, has been subjected to careful analysis; and I should suppose no such analysis has been made, because no chemist, even with a careless examination, could have failed to observe that it contains a peculiar principle, the discovery of which would have given the analysis publicity.

The petroleum of Rangoon, at ordinary temperatures in this country, is a soft solid, of the consistence of lard. Its specific gravity, at the temperature of 60° Fahr., is 880, water being 1000. At the temperature of 86°, it is of the consistence of thin paste, and at 90° *it melts* completely, and forms a *sluggish liquid*, which acquires more fluidity as the temperature rises. Hence in the East, during the hot season, when it is dug for, it must be in the fluid state, and consequently entitled to its vulgar name of ground-oil. It has a powerful naphthous odor, different from that of most other petroleums.

It is impossible to analyze this petroleum by means of the ordinary chemical solvents. Most of these solvents, such as the acids and alkalies, have little or no action on it, while alcohol, which acts feebly, and ether and the volatile oils which act energetically, dissolve all it

principles indiscriminately. The only practicable method of analysis, therefore, is the process by distillation.

When six ounces of petroleum were distilled, there was first procured, at a low heat, an ounce of nearly colorless naptha; then another ounce of straw-yellow naphtha; then, at a higher heat, about another ounce, much more yellow, yet still fluid at 60° Fah.; next, a considerable quantity of a yellowish liquid, which concreted at 60° into a loose mass, composed of numerous crystalline needles and plates, in a yellow naphthous fluid; and, as the distillation went on, this matter became more and more solid, but even towards the end was not firmer in consistence than lard. The residual matter in the retort, when the heat had been raised to full redness, was a spongy charcoal.

The naphtha, when rectified by a second distillation over a lamp, and then by a third distillation from the vapor-bath, is limpid and colorless, like sulphuric ether, and its density as 779. From the trials I have made, I consider that the Rangoon petroleum, when distilled on a large scale, will yield nearly a third of its volume of this colorless naptha.

I need scarcely observe, that in eastern countries, where the fresh juice of the caoutchouc tree cannot be procured, the naptha from the Rangoon petroleum may prove a useful article. Like other kinds of naphtha it freely dissolves, or rather softens, caoutchouc; which, after the evaporation of the solvent, is recovered with its original properties. When it is to be used for this purpose, however, it must be carefully separated by distillation from the crystalline matter I am presently to describe, which rises as the distillation advances, and gives the naphtha a yellow color. For if any material proportion of this impurity be present, the caoutchouc solution dries very slowly, and long retains a greasy surface.

The yellowish, concrete, crystalline matter, like the petroleum itself, is not acted on by the caustic alkalies, or by the strong acids. Alcohol dissolves it very sparingly; ether and the essential oils, freely and entirely. None of these solvents, therefore, is of any use for separating the crystalline matter from the mass. But I have succeeded in procuring it in a state of purity by the following process:

The mass being cooled down to about 40° Fahr. it was spread out on the filtering paper, and then subjected to strong pressure between many folds of common blotting paper. In this manner, an oily-like matter was taken up by the paper, and a pale yellowish white crystalline substance was left, which was subsequently deprived of its remaining color by repeated solution in boiling ether and recrystallization. Ether dissolved it largely, forming a pale yellow solution, which, on being cooled by immersing the vessel in very cold water, became a soft mass of interwoven crystals. This mass was then taken out, spread quickly on filtering paper, and immediately subjected to strong pressure between folds of blotting paper. The yellow coloring matter, which all remained in solution in the ether after it cooled, was thus, in a great measure, imbibed by the paper; and the crystalline matter was procured in a state of purity by repeating this process twice.

On first procuring this crystalline substance, I considered it as the same with the napthaline procured not long ago from coal-tar by Mr. Kidd, as related in his paper in the Philosophical Transactions for 1821. This opinion I was led to form from the appearance of the crystals, the nature of the substance which yields them, and the process of distillation by which they were procured.

On a careful examination, however, I find that the crystalline principle of petroleum differs materially from that of coal-tar, as well as from every other known body; and I shall therefore beg leave to denominate it *Petroline*, according to the analogy suggested by the name of Mr. Kidd's crystalline principle.

As procured by the process described above, petroline forms foliaceous masses of small crystals of snowy whiteness, and bright pearly lustre. It is somewhat unctuous, and has a naphthous odor, which becomes very faint on exposure for some time to the air, and is removed altogether by boiling in alcohol. It fuses at 135° into a transparent, limpid, colorless fluid; but softens ten degrees lower. From a state of fusion it concretes on cooling into a translucent brittle mass, like wax, the density of which is 909 at 60° Fahr. At a temperature intermediate between the boiling point of water and a low red heat,

the fluid boils, and distillation takes place. The greater part of the petroline condenses in the form of a fluid, which becomes, on cooling, a translucent waxy mass, with its original properties. But, owing to the elevated temperature required for its distillation, a part is decomposed, a little charcoal is left behind, and a small quantity of inflammable gas passes over with the undecomposed sublimate. When heated in the open air, it catches fire, and burns with a dense white flame and much black smoke.

Petroline is insoluble in water, cold or boiling. Boiling alcohol takes up a small quantity, not more than a 450th of its weight, and, on cooling, deposits the greater part in minute shining crystals. Boiling ether, its proper solvent, easily takes up a fifth of its weight, which, on cooling, is in a great measure separated in a congeries of micaceous crystals, so abundant as apparently to convert the ether into a solid mass. Oil of turpentine also dissolves it in large quantity, and so does naphtha.

Caustic potass and caustic ammonia in solution have no visible effect on this substance. When boiled with it, it simply fuses, rises to the surface, and is there found, on cooling, with its usual properties. Concentrated muriatic, nitric, and sulphuric acids, are equally without action, even when aided by the heat necessary to boil each. It simply melts and rises to the surface, and, except that it becomes slightly yellow with nitric, and slightly brown with sulphuric acid, no change of property is perceptible. It has no action with acetic or oxalic acid.

With iodine, aided by a gentle heat, it quickly unites, forming a violet-colored fluid, which, on cooling, becomes a dirty greenish-brown solid, very soluble, like each of its elements, in sulphuric ether.

I have not made any inquiry into the other chemical relations of petroline, my object at present being merely to establish its claims to be considered a new principle, distinct from any other hitherto known. In its properties it resembles napththaline more than any other substance; but, at the same time, it differs from that body in very many respects. Naphthaline volatilizes at common atmospherical temperatures; does not fuse under 180° Fahr.; and, when heated a little above 400°, boils and sublimes in fine micaceous crystals. It is heavier than water. It forms a rose-colored solution with acetic or oxalic acid; and with sulphuric acid it unites to form a peculiar acid, termed the sulpho-naphthalic, which, like other acids, neutralizes bases, and forms salts with them. A single glance will satisfy every one how completely this account of the properties of naphthaline differs from the description given above of the properties of petroline.

It remains for me to determine its elementary composition. This I have not hitherto found leisure to accomplish; but I am engaged in the requisite experiments at the present moment, and will soon make them known to the society. The experiments hitherto made merely enable me to say, that it contains a very large proportion of carbon.

Appendix, December, 1834.—A few months after the preceding paper was read before the Royal Society, the author observed in Buchner's Repertorium, an account of the discovery in 1830, by Dr. Reichenbach, of a crystalline principle in tar, to which that chemist gave the name of paraffine.* As the properties of paraffine seemed from that account to be obviously identical with those of the petroline of the Rangoon petroleum, and as Dr. Reichenbach had ascertained its properties and composition fully, any farther investigation of the crystalline matter of petroleum appeared unnecessary. The original paper is now published, partly because allusions have been made to it in chemical works, and partly to serve as an introduction to the ulterior inquiry of Dr. Gregory on the same subject.

The author, soon after laying this paper before the Royal Society, examined by the same process the petroleum of St. Catherine's, near Edinburgh, of Rochdale, in Derbyshire, and of the island of Trinidad; but was unable to detect a similar crystalline principle in any of them.—[Transactions of the Royal Society of Edinburgh, Vol. xii., Part i., p. 118-123.

ON THE FUSION AND APPEARANCE OF

* A notice of Dr. Reichenbach's researches on Paraffine will be found in the Repertory, third series, vol. xv., p. 34, in the number for January, 1833.

REFINED AND UNREFINED COPPER. By DAVID MUSHET, Esq.—The following are "a few extracts from experiments made some years ago, with a view to ascertain what effect would be produced upon the strength and malleability of copper, by retaining, to a certain extent, the alloy (chiefly tin) which is found in rough copper, and which it is the purpose of the copper refinery to discharge. In the first place, I obtained a quantity of shotted rough copper, made from the furnace in which the copper, though alloyed with other matters, first appears in its metallic form. These shots were light and flaky, hard when struck, but at the same time partially ductile. A quantity of pure shotted copper, made from the refinery, and having the form of flattened spheroids, and much denser than the other, was procured at the same time for the purpose of these experiments.

Exp. No. 1. A quantity of rough copper was fused in a black-lead crucible with nearly an equal bulk of charcoal, and poured into an open iron mould. The bar or ingot thus made was three-fourths of an inch thick, and when cold and broken, was found to have crystallized in converging striæ perpendicular to the upper and lower surfaces, and declining towards the outer edges of the bar. The grain was of a pale color inclining to gray, indicating the presence of tin.

Exp. No. 2. Three bars procured in this way were melted together in a black-lead crucible, without charcoal, and poured into a mould just at the moment when the melted copper put on a creamy appearance. When cold, the surface of the ingot thus obtained was less coppery-metallic than the surface of the ingot in the first experiment, where charcoal was used; from which it may be inferred that, owing to the absence of charcoal, a certain degree of refinement had taken place. The fracture possessed more of the red grain of good copper; the striæ were less distinct and less crystalline; and the surface, instead of being convex, as in the first experiment, was concave.

Exp. No. 3. Some of the pure shotted copper was fused in a black-lead crucible with an equal bulk of charcoal, and the resulting ingot presented a more clean and perfect mass of copper than the ingots obtained in Experiments No. 1 and No. 2. The fracture presented a series of brilliant striæ arranged from surface to surface, breaking off easily in the direction of the perpendicular fibre, a structure which seems wholly incompatible with extension or malleability.

Exp. No. 4. Some of the same pure copper melted similarly, but not poured into the mould until it had nearly lost its fluidity, formed an ingot less striated or crystallized than any of the former, with more of that minute deep orange-colored grain which is peculiar to pure and malleable copper. From the results of this experiment, and of No. 2, it would seem that when copper is poured into the mould at as low a temperature as is consistent with perfect fluidity, the fracture is less crystallized, and the color approximates to that ruby grain which indicates the malleable state of copper.

Four bars, one from each of the foregoing experiments, were imbedded in burnt lime, shut up from the access of air, and exposed in crucibles to the same temperature. The pure copper bars (Nos. 3 and 4) were on the surface considerably oxidated, but those made from the rough copper (Nos. 1 and 2) were entirely free from oxide; and from this it may be inferred that the alloy (principally tin) which still remained in the copper, prevented waste or oxidation. The bar from Experiment No. 1 was not cut, but that from Experiment No. 2 retained about the same quantity of grained striæ as before the cementation; though, compared with a fracture of the same copper that had not been cemented, the grain was redder, the color more brilliant, and the metal more ductile. The bar from Experiment No. 3 was covered with a thin coating of crystallized oxide exceedingly soft; the striæ were more enlarged and adhesive, so that the copper, in cutting, tore out in flakes, which separately were soft and ductile. The bar from No. 4, when examined and compared with an uncemented one, was more open in the grain, redder, and more brilliant; but the quantity of depth of grain was nowise altered, although the metal cut softer, and was covered with a thin crust of shining oxide. From these details it may be presumed that cementation opens the

grain, renders the bar less dense, but does not change the peculiar form of the arrangement. In each case, the copper after cementation was softer, a change which seems favorable to rolling cold. The impure or rough copper appears to be alloyed with another metal (no doubt tin,) which prevents that oxidation which pure copper in the same circumstances would undergo.

Besides the above, several bars were made from the rough copper by a slower fusion, and with a longer exposure to the charcoal, and it was observable, that the longer the exposure, and the slower the fusion, the more yellow and refined was the copper in the bar.

Some of the bars produced in the course of these experiments were attempted to be rolled; but the success was various. Of those made from the pure copper, some rolled better and others worse than any made from the rough copper; one or two bars of the latter were equally malleable with the former; but none rolled well either hot or cold. In those bars in which the striated arrangement was most perfect, the capacity for rolling was least, and those in which the minute granular fracture prevailed, generally rolled the best. It certainly does appear that this tendency to crystallize, so destructive to malleability, is peculiar to English copper made from the crucible. There are occasions, no doubt, when, the proper temperature being hit upon, the bar would roll; but these occasions are so rare and uncertain, that English copper made in this manner could not be relied upon in the manipulations connected with manufactures. There is no question that the arts in this country suffer from the peculiarity of English copper. For, in consequence of it the malleabilization of that metal is necessarily confined to the original process of refining practised on the great scale by the copper smelters. It is very different with Swedish and Russian copper, which I have seen melted in considerable quantities in large crucibles, cast into cakes or thick sheets, and afterwards rolled into boiler-plate and thin sheet-copper. This subject requires and deserves a scrutinous examination, with a view to discover the cause of the uniform tendency of English copper to crystallize; and that cause may, perhaps, be found in the process employed in this country for the smelting of copper ores, a process which, however economical and well calculated to overcome quantity, has never yet produced pure copper.—[London and Edinburgh Philosophical Magazine, May, 1835.]

[From the London Mechanics' Magazine.]

HYDRAULIC BLAST WHEEL.

In foundries, smithies, and other manufactories, large quantities of atmospheric air in rapid motion are in constant demand, and a large proportion of the motive power is spent in the supply. The pressure of fluids being equal in all directions, the aggregate amount of force employed in transmitting air by means of bellows, air cylinders with pistons, &c. is very considerable, there being the same pressure on every square inch of the blowing apparatus as on the like space of the orifice through which the air is transmitted.

The accompanying drawings represent a blast wheel lately invented by me, of which the following is a description. I have had a model of it made, and it fully verifies the correctness of my calculations; and in this case the effects must be the same in proportion on a large scale.

Fig. 1. A is a hollow cylinder (the length of twice its diameter,) which is made to revolve on the pivots O by means of a rope or belt acting on the pulley B, or by any other mechanical power. C is a stationary nose or tube, fixed to the side of the oval trough D. The trough is nearly full of water, its level being above the centre of the cylinder A, and of the small cylinder within it, hereafter described. Within the cylinder A is a spiral leaf wound round a cylinder of about ⅓th of the diameter of the external one. The size of the internal cylinder need not be increased in proportion to that of the external. The leaf is soldered to both cylinders, and so rendered air-tight; it may be made of the slightest material.

Fig. 2. The water is here seen occupying the lower half of the cylinder and trough, the top being always filled with air. On the wheel's making one revolution, the *water* in E is conveyed into F; that which was before in F escapes at G, and flows round the side and bottom of the trough, outside the cylinder, to re-enter the latter at H. The air in I (which is continually supplied by atmospheric pressure of 15 lbs. to the square inch) is conveyed to K, and so in proportion for less than a revolution; and the air which was before in K is forced through the pipe at C, to which branch pipes may be attached. A continuous blast

Fig. 1.

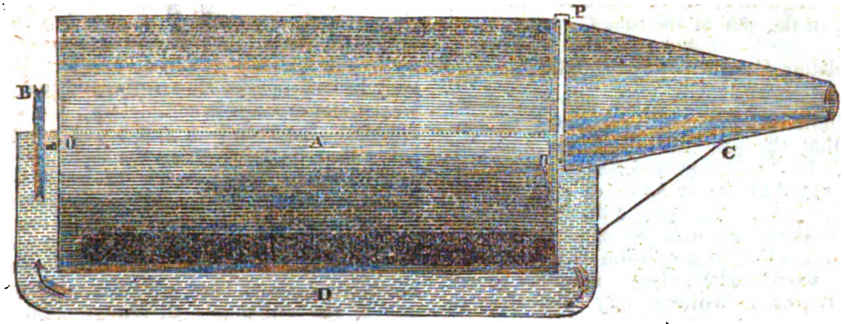
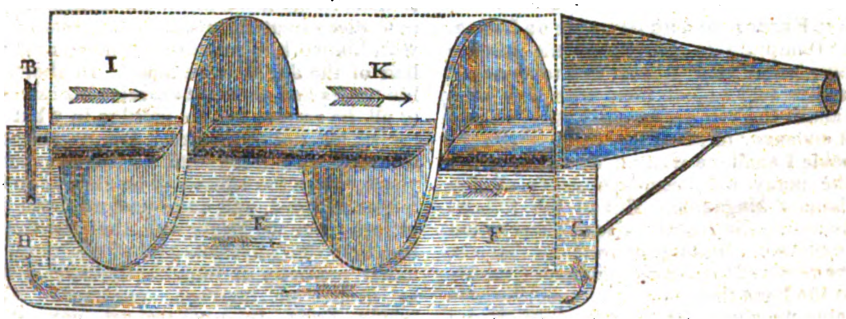
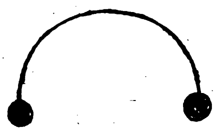


Fig. 2.



of air is thus produced, and may be conveyed to any part of a building. The pressure of the water being equal on all sides, and as it is set in motion by the inclined plane of the screw, but little power is required to keep the wheel going, for the particles of fluids move easily amongst themselves. The trough should be of an oval form. In order that no air may escape between the tube and the cylinder, a small strap of leather is fastened to the tube (which is fixed) to lap over the cylinder at P, fig. 1, and is kept down by a small weight, hung at the corner of each side, thus,

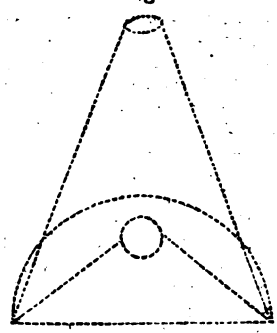


No air, once enclosed or detached from the atmosphere by the end H of the spiral leaf being immersed in the water, can possibly escape but through the nose or tube.

Fig. 3. Transverse sections of both ends of tube; and outline, as seen from its under side.

The wheel may be made of any size required. To ascertain the quantity of air discharged at each revolution: First, find

Fig. 3.



the whole contents of the cylinder, which we will suppose to be 14 feet in diameter, by first finding the area of the base by multiplying the square of the diameter by ·7854; then multiply the area by the length of 28 feet, thus, 14×14=196×·7854=154 nearly, ×28=4312, contents of cylinder. But as it takes two revolutions to empty the cylinder, 4312÷2=2156 feet of air and water discharged at each revolution, 2156÷2=1078 feet of air less 78 feet for internal cylinder, &c.=1000 cubic feet of air discharged at every revolution. If the motive power, or the velocity, cannot be

easily regulated, a sliding-valve may be made in the side of the tube C.

ALFRED T. J. MARTIN.

Helston, Cornwall, June 6, 1835.

P. S.—Since writing the above, a practical difficulty has been suggested to me, viz. that the pressure of air for smelting should be 2, 3, and even 4 lbs. to the square inch, equal to the pressure of a column of water about 7 feet high. I do not see how this desideratum can be obtained by the foregoing plan; but still the invention may prove useful where large supplies of air are required without any considerable pressure.

[From the London Mechanics' Magazine.]

EVIL EFFECTS OF THE DIVISION OF LABOR.—In attempting to prove that the minute subdivision of labor has an evil tendency, I am aware that I shall meet with few who will admit the evil to be so extensive as I shall endeavor to point out; and it is very probable I shall be written down by some of the many able correspondents of the Mechanics' Magazine. But as the following facts are the results of long observation and experience among the working classes, I have resolved to publish them anonymously, in the hope that they will meet the eye of some who may be benefitted by them; and should they be the means of convincing even one, I shall consider myself happy in having brought the subject into notice. I have myself served an apprenticeship to a mechanical profession, and had then ample opportunities of observing the causes that tend to bring about the moral degradation of some of the working classes.

That the division of labor produces a cheaper article, and is a great source of national wealth, I readily admit. I believe were it not for this very cause, Britain would ere this have lost her political status among the nations. Groaning under a load of taxation, which no other nation on earth could have borne, we have been driven into an artificial state of society, and the division of labor with all its attendant evils is one of the results. This is illustrated by the fact that we export machinery to countries where workers are obtained at half the price: and yet these countries are unsuccessful competitors in the same market with the poor tax-eaten British. Our national vanity whispers that this is owing to our superior genius; but I contend that it is our artificial mind-degrading system of dividing labor, which by making individuals do only *one part of a thing*, with mechanical, or rather slight-of-hand, rapidity, enables us to produce a whole as cheap as our foreign brethren.

But the effects of this system upon society is truly deplorable. A poor boy, with very little education, is bound an apprentice for five or seven years, to do one particular act; he commences cheerfully, and in a few weeks can manage it completely; the only difference between him and a journeyman being that he takes twice the time. He is now doomed through life to be a *mere machine*; all the delight he felt in learning his trade is over; he has no more mental work to perform, and he goes on from day to day with his monotonous task without excitement of any kind, save the temporary one of the gin-shop: there, amongst the rudest ribaldry and mirth, he is exhilarated and *comparatively* happy. Next day he returns to his labor in the most melancholy and discontented mood, and hastens on with his work to procure the means for "a hair of the dog that bit him." In short, as his profession does not exercise his intellect at all, he cannot fail to indulge in what *he* thinks his only pleasure. Let us suppose this to be continued until he reaches man's years, when the effect will be seen in an intellect, blunted, and quite useless from inaction. For we know well, that the thinking, like the physical, part of the man, is either perfectly or imperfectly developed—by proper or improper exercise. This man's brain is unexercised, nay, it is diseased; he has acquired a sensual and ungovernable appetite for the drug that enfeebled, and still continues to enfeeble, both his mind and body, and he is in such a morbid state, that all his efforts to reform or improve his mind are ineffectual. He tries Mechanics' Institutions, and all the other schemes for improving the working classes, but to no purpose; his mind, from want of habit, cannot follow the lecturer; he gets inattentive—sleeps—and loses the thread of the subject; repeats his visits for a night or two, perhaps, and the lectures get to him "the longer the drier," until he quits in disgust, what might, under other circumstances, have been a source of enjoyment to him. When such a character enters into the solemn engagements of matrimony, his previous habits and badly regulated mind ill qualify him for the various duties of husband or father; he brings into the world a few squalid, degenerated wretches, and by his brutal conduct, drives his well-disposed partner to that temple of infamy the gin-shop, for the melancholy purpose of "drowning her cares." I will not disgust the reader by dwelling upon the united effects of their example on their thus hereditarily vicious offspring. The wretched man continues to work and drink alternately, until he reaches the workhouse if in England, and beggary and crime if in

Scotland: a poor grumbling, discontented, shameless pauper, both unable and unwilling to work; for the man who has spent twenty years of his life sharpening pin-points, or guiding a self-acting turning machine, has not physical strength to handle a spade or road hammer, even if he had not been previously wasted by dissipation. This is not an exaggerated picture; the melancholy details of evidence brought before the Factory Commission furnish multitudes of such instances. It is not the long hours, however, that is the sole cause of this evil I maintain: it is the division of labor that is the root of the evil, which I shall endeavor to illustrate by another example, *not ideal*, but like the former, *real*: and the writer has many characters under his own eye, of both kinds, to choose from.

In Scotland, some ten or twelve years ago, the division of labor was not (and is not even now) carried to the extent that it is in England, and consequently the working classes have a higher moral character, which is commonly ascribed to education, and a modern training. This is the case in a very few instances; by far the greater number of the Scotch mechanics and operatives receive a very limited education. When they are sent off to a trade, they can half read, and perhaps make shift to write the letters of their own name—but the difference rests here; the Scotch mechanic has to do a great variety of jobs, not one of which he can do so quickly as the expert Englishman.

As an instance: About twelve or fourteen years ago, an engine-maker had to learn to make a tolerable good pattern; he had to turn both iron and wood, to fit up, put together, and attach the engine to the factory; he had thoroughly to understand drawings, and in many cases had to draw himself. The reader will readily imagine, that this must be a clumsy "Jack of all trades:" this is not the case however,—he is a slow, but a good workman. Suppose exactly such a boy as we took in the former case, bound apprentice to this trade for seven years: for one year he is allowed to run loose about the work, he is every "body's body," runs messages, creeps into holes to do jobs which men cannot reach. By the end of the year, he has acquired a very rude general notion of the whole work, but can do little or nothing with his hands. He is now stationed at a bench, and from making simple articles, comes on with great satisfaction to himself to make good patterns; he then wearies, because he thinks himself master of the subject; having little mental work to perform, he is now in great danger of going astray, but happily for himself he is shifted to another department, upon which he enters with great spirit, and feels with intense delight, as bit by bit he masters the various tasks put before him. His brain thus stimulated and exercised, a thirst for knowledge is created, and he is driven in search of food for his mind to a Mechanics' Institution, where he hears and sees, for the first time, the astonishing fact, that the water he drinks is composed of two gases that burn. This leads him to endeavor to read, that he may learn more of the matter, but he finds he cannot do it so quickly as he would like; he then sets to work with good will, goes to an evening-school, and his mind being in an excellent state for receiving instruction, he makes most rapid progress. I need not trace him farther—here is a useful and promising member of society, who himself enjoys life and all its blessings. A few such (according to the strength of their intellect) turn out eminent men—the rest are scattered over the earth in the shape of managers, superintendents, and foremen, of flourishing works; and it is worthy of remark, that in all the large manufacturing towns in England you find a large proportion of Scotchmen doing the intellectual work of large mechanical establishments. This does not arise (as Sandy's vanity always suggests) from a "national superiority." John's head is just as good as his, as is seen in every case where there has been the same chance of getting the organs developed. I regret to state that the baneful system of dividing labor is fast spreading in Scotland, and the moral degradation attending it cannot be denied by the most ardent admirers of the religion and morality of that country. It must not be supposed that the character I have last attempted to describe has been exempt from temptation. No, he has kept company with the drunken and the dissolute (of which there must be a large proportion in every society;) but his mind having been properly set to work, he soon calculated the amount of real pleasure or pain to be derived from seeking after knowledge, or from a course of profligacy. Nor must I be understood as assuming that all are depraved who labor at one particular object all their lives, for there are some minds that naturally resist the influence of such causes; but the number of the good bears a small proportion to the bad in countries where this vicious system is carried to great extent. There is another demoralising effect yet to be noticed, which I shall endeavor to do as briefly as possible. An improvement in machinery often turns hundreds adrift upon society, who having spent the best part of their lives in some such trifling work as heading pins,

are too old to learn another business, and for reasons already mentioned they cannot do out-door work; their minds being untutored, they do not make a very vigorous effort to do their best at a new job, well knowing that they will not be allowed to starve in England. In many, very many cases, such men direct their blind rage to the breaking of machinery, not only the machine which superseded them, but machinery of all kinds; in short, a large proportion of the seditious, the incendiaries, the swings, machine-breakers, &c. which disturb the peace of society, are division-of-labor people, thrown out of work, and who have neither physical nor mental strength left to turn themselves to another decent employment, seeing that the few that do so are scarcely fit to earn sufficient to support a miserable existence.

It is common enough to hear the *lordly* aristocrat, or wealthy man of business, express their *disgust* in such unmeasured terms, as the "beastly multitude," the "canaille," the "scum of the earth," &c., and grumble loudly at the overwhelming poor-rates. Let them examine themselves carefully, and see that they be not aiders and abettors of such infamy. Let them remember, that the cause of this evil is *over-taxation* (and every one who directly, or indirectly, robs the public purse, is to blame for perpetuating the evil,) and not turn away in disgust from his fellow-being whom he has already injured.

We take some trouble to educate the lower animals, and if some of these our humble servants are not so tractable as could be wished, we do not vent our anger upon them, but upon their trainers. Why, then, should the higher classes *spurn* the poor, misled, untrained mechanic, whose labor has perhaps enriched them? It were a wiser course, and a way to root out the evil, were they to set on foot a proper plan of national education, inquire into, and amend, some of the absurd apprentice-laws, and put the rising generation in the way of acquiring more than one branch of a business, in order that their minds may be so far exercised as to make them good members of society, instead of converting them into *mere machines* for the acquisition of wealth. We see the good effects produced in the middle classes by education. Why, then, should a large proportion of our fellow-creatures be allowed, or rather doomed, to remain in a state of darkness? I trust these remarks will be followed out by some of your abler correspondents at some future period. I am afraid I have already occupied too much of your valuable space. L.

May 4, 1835.

VISIBILITY OF STARS IN THE DAYTIME.—Sir: On the 384th page of vol. 3, of the Scientific Tracts, I have noticed an article relative to the "Visibility of Stars in the Daytime." In answer to a request at the close of that article, I send you the following extract, from "*Lecons d'Astronomie, par M. Arago, imprime a Paris, 1835.*"

"It is a very common error to suppose that stars can be seen *in the daytime,* from the bottom of pits, or wells. They cannot be seen during the day, only by *the aid of* telescopes, or by rising high in a balloon, or from the summits of lofty mountains. The cause which prevents their being seen with the naked eye during the day is, that the rays of the sun, reflected by the atmosphere, form a luminous veil, which obstructs the feeble light of the stars. If one body emits less than one-sixtieth as much light as the other, it becomes invisible. This can be verified by a simple experiment: place an opaque body between two lighted candles, so that the body will project two shadows; remove one of the candles so far that the light it throws upon the opaque body shall be only one-sixtieth as great as the light from the other candle. This is easily done, if we remember that the light diminishes as the square of the distance increases. The shade produced by the most distant light will no longer be visible. This is the principal reason why stars can be seen with a telescope in the daytime; the telescope diminishes the apparent distance, and accelerates in the same degree the motion of the stars." D. — [Scientific Tracts.]

APLANATIC ENGISCOPE. — This is the name of a new instrument, on exhibition in the city of Troy. The Advertiser says, it possesses all the improvements of the microscope, from its first invention in 1612, up to the present time, and of Dr. Goring's and Mr. Prithard's Diamond and Sapphire Aplanatic Engiscope. Aquatic objects may be seen in the smallest *particle of clear* water, magnified to a vast extent. With the instrument one can examine the external and internal organization of the smallest animalculæ; see the motion of the fluids as they thread their way through the exceeding minute vessels which traverse in every direction the bodies of these atoms of creation, many of which are computed to be thousands of times smaller than a grain of sand, but whose bodies and all their several parts are shown by the microscope to be as perfect as those of the elephant. The skeleton larva of many of our winged insects, animalculæ in common vinegar, paste eels, dust from cheese, (which is shown to be composed of living animals,)

beautiful cuttings of wood, (showing the course of the circulation of the sap,) insects inhabiting ripe oranges, &c., together with many parts of the animal creation, too small to be examined by the unasisted eye, are presented by this wonderful instrument with a distinctness which, to be duly appreciated, must be examined. In the solar and hydro-oxygen microscopes, the spectator is presented only with the shadow of the animalculæ, thrown on a whitened screen; but in this engiscope not the shadow, but the reality is exhibited. A writer in the Troy Whig pronounces the instrument to be all that is represented in the advertisement. It is said to have been constructed by Mr. Conner, a citizen of Albany.—[Ib.]

[From the London Mechanics' Magazine.]

DAGLISH'S PRIZE RAILS AND PEDESTALS.

Dear Sir,—I herewith send you drawings of my parallel rail and joint and intermediate pedestals, with the mode of fastening them to the stone blocks or sleepers, and also of my method of keying the rails into their respective pedestal; for all which I obtained the premium lately offered by the London and Birmingham Railway Directors, with the exception of the mode of fastening the pedestals to the stone blocks, which the Committee of Reference are said to have thought inferior to the lewis-pin of Mr. Swinburn, to whom the Directors accordingly awarded a third of the premium. I have also added sketches of certain modifications of my rail and pedestals, which it might be advisable to adopt under particular circumstances, and in some peculiar localities.

Fig. 1 (No. 8 of the Competition) is an end-section of the parallel rail and *joint-pedestal* (the pedestal where two ends of different lengths of rail meet;) showing also the mode of keying the rail by cotter bolts, (No. 3 of the Competition.) Fig. 2 is a plan of the above; and fig. 3 a side-section. The weight 50 lbs. per yard. The stone blocks are from 10 to 12 inches thick, and contain from 4 to 5 cubic feet; the cotter bolts are ¾ inch round.

I have tried this form of rail against ten other forms of rail of the like weight per yard or thereabouts, not only by actually running heavy locomotive engines over them, but by means of the steelyard and lever, and have always found that it will carry more weight than any other with the least deflection. The simplicity of its construction, too, is greatly in favor of its being soundly made.

Fig. 4 is an end-section of the same kind of rail, with the *intermediate pedestals*; and fig. 5, a plan of the same.

The joint-pedestal is made of nearly twice the bearing of the intermediate ones, in order that the ends may be the more effectually secured.

The Secretaries of the London and Birmingham Railway state, in their letter to me announcing the award of the premium in my favor, (with the exception aforesaid,) that the Committee of Reference did not consider that any one of the patterns or plans sent in fulfilled the conditions required by their advertisement, (that is to say, I presume, combined in one all the advantages sought for,) but that my form of rail and chair, (or pedestal,) and mode of fixing the rail to the chair, (according to the chair pattern, No. 3, and model, No. 8,) were the best as regards the two first conditions of the advertisement; while the method of fixing the chair to the stone block, shown in model No. 5, (Mr. Swinburn's,) was the best as regards the third condition; and that the Directors had, therefore, come to the unanimous resolution, that they should not be justified in giving the premium for any one individual pattern or plan, but that 70*l*. of it should be awarded to me, and 35*l*. to Mr. Swinburn.

On comparing, however, the statements in this letter with those in the pamphlet lately published by Mr. Barlow (one of the Committee of Reference,) containing an account of the experiments made by him at Woolwich, and his Report thereon to the London and Birmingham Railway Directors, I must confess that I am quite at a loss to reconcile the two. For it appears from the latter, that Mr. Barlow not only made his experiments with my form of rail, which he pronounces to be by far the best, but recommends the mode which I proposed of fixing the pedestal to the stone block, *and not Mr. Swinburn's*.

Indeed, to all who are practically conversant with railways, it must seem as inexplicable as surprising, that the lewis-pin method should have been thought worthy of favorable mention at all, far less of being honored with a premium. Were such a mode of fastening adopted, (as it, most assuredly, never will,) it would not be long before the concussions from the passage of heavy locomotive engines, at great velocities, would infallibly split the stone to the depth of the lewis.

The mode of fastening practised by me, and approved of by Mr. Barlow, (though, strange to say, not treated with like favor by the Committee of Judges, of whom Mr. Barlow was one,) consists, as will be partly seen from inspection of the figures, in inserting plain cotter bolts through the stone, and countersinking the hole up from the bottom for the space of an inch and a half

or two inches, so as to permit the point of the bolt to drop below the base of the pedestal. I first tried screw-bolts, but was obliged to abandon them in consequence of the nuts getting, through corrosion, so fast to the bolts as to twist the bolt-ends off before they would unscrew. Fifteen years' experience has now satisfied me that the plain cotter bolt is the only one that will answer.

Mr. Barlow speaks of this method of fastening as if it were the suggestion of Mr. Vignoles. But how he should have fallen into such a mistake, I cannot comprehend; for it was not only fully shown in the models I sent in to the London and Birmingham Railway Directors, but the advantages of it were particularly dwelt upon in the letter which accompanied them. To place this beyond all doubt, I will here repeat those passages of my letter which relate to this point:

"The pedestal for the joint I would particularly recommend to be fastened to the sleeper with cotter bolts; I would also prefer fastening all the intermediate ones in like manner, though they would answer to be well nailed in the usual way, but much better with cotter bolts, as you then derive the greatest effect from the parallel rail, by keeping every pedestal firmly down. If only nailed, this may prevent the intermediate pedestals becoming fulcrums, in which case the fibres of the upper surface of the rail are not called into tension in the same ratio with those on the under side of the rail, immediately between the pedestals, while the locomotive or any other heavy carriages are passing along the line."

Again:

"I prefer the mode of fastening the pedestals with cotter bolts as by far the most effectual for general use; if even they have to be fastened with smaller bolts, (say ⅞ths diameter,) more especially when they can be thus secured at as cheap a rate as if fastened by nails. The holes for the small bolts can be drilled through the stone sleepers for less than the large holes necessary to receive the wooden plugs; and the small bolt and cotter will only cost a trifle more than the nail and wood plugs, as both the bolts and cotters can be made by a machine for that purpose."

Mr. Vignoles, though he certainly did not suggest the use of the cotter bolt, has done me the honor to cause it to be adopted in the construction of the Dublin and Kingstown Railway, instead of the nails or spikes commonly used.

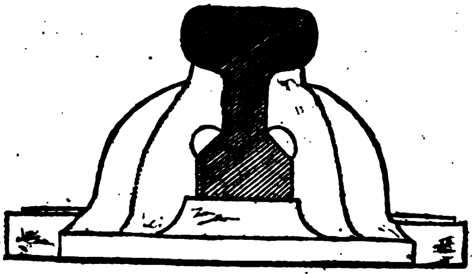
Mr. Barlow makes some very forcible observations, (which, in noticing his pamphlet, you have judiciously transferred to your pages,) on the importance of exact fitting and fastening; but to show you that all practical men have not been so indifferent to these matters as Mr. Barlow imagines, and indeed somewhat broadly insinuates, I will, with your leave, make another short extract from my letter to the London and Birmingham Railway Directors, which has an immediate bearing upon this part of the subject:

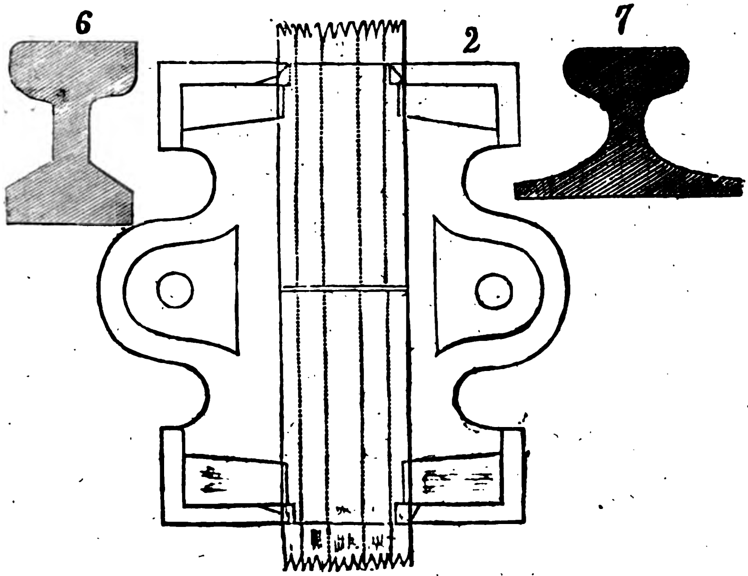
"I am quite sure a velocity of from 50 to 60 miles per hour may be obtained upon a well-constructed railway, with greater safety than one of 20 miles, upon any of the present lines yet in operation; not only from their having *too* tight a rail and ill-constructed pedestal, but from the mode of fixing them, *especially at the joints*, which is the great cause of so much deflection and sudden action, both vertically and horizontally—so that it is not in the power of man to make a locomotive engine to stand the action they are subject to long together.

"I have frequently stated to Companies, that every public railway ought to be laid down as accurate and as firm as it is possible for hands to do them; and, when that is done, to put a steam engine upon them to plane the surface, the same as we do our slide-rails."

I must also use the freedom to observe that, correct as Mr. Barlow's views are, of the importance of executing all railways in the best possible style of workmanship, he shows, in nearly all that regards the details, great want of practical knowledge. Speaking of keying the rails to the pedestals, he says, that "if the rails and chairs must not be permanently fixed to each other by direct means, it ought not to be attempted by indirect means, viz. by cotter keys or wedges, for either these will hold the rail to the chair, or they will not; if they do hold fast, they produce all the mischief which permanent fixing would occasion; and if they draw, then they do no good, although they may still do mischief." Now, if the Professor ever had an opportunity of carefully watching for a summer's day the passing of heavy steam carriages and long trains of other heavy carriages over a railway, he would never have ventured such a statement. He would have witnessed, that it is scarcely in the power of man to fasten the rails permanently to the pedestals. Aware of the impracticability of doing so, I do not allow the D key proposed by me, (see fig. 1,) when used to key the rail to the *joint*-pedestal, to be driven with more than a single-hand hammer; and I also stop it at its place when driven, the key being here merely intended to act as a steadiment to the rail. For before a locomotive engine or heavy train has passed twice over the rails, the whole of the

Fig. 1.





keys give or yield of necessity in such a manner as to allow the rails to expand or contract more than double what they really do, or are subject to, from the differences of temperature to which they are exposed. With respect, however, to the *intermediate* pedestals of the five-yard rails, the more soundly they are keyed to the rail the better, so as not to injure the pedestal by overdriving the key, as there is more latitude in the holes through the base of the pedestals where the bolts pass, than would compensate for treble the expansion and contraction the rails are subject to. Besides, each of the holes drilled through the stone blocks upon which the pedestals rest is drilled $\frac{1}{8}$th of an inch larger than the diameter of the bolts, and the pedestals can never be so hard cottered down to the surface of the stone but what they will give a little. All difficulties on this head I got completely over several years back, in both wrought and cast-iron railways, which have been laid under my direction. I could refer Mr. Barlow to several miles of railway which have been worked for years, and remain at present perfectly firm, without the least distortion, either vertically or horizontally.

Again: notwithstanding Mr. Barlow has actually proved by experiment that the parallel rail is superior to the parabolic, or fish-bellied rail, and has taken some pains to show the neutral axis, which has little or nothing to do with the best form of rail; yet he has forgotten to point out one of the most essential advantages which the parallel rail has over the parabolic rail, as I have frequently proved by the steelyard lever. I have found that by holding the ends of the rails firmly down, at the joint-pedestal especially, the parallel rail of fifty per yard will carry upwards of a ton more, with the same deflection, than they will do if the ends are

Fig. 3.

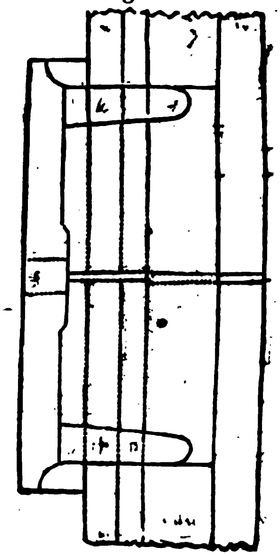
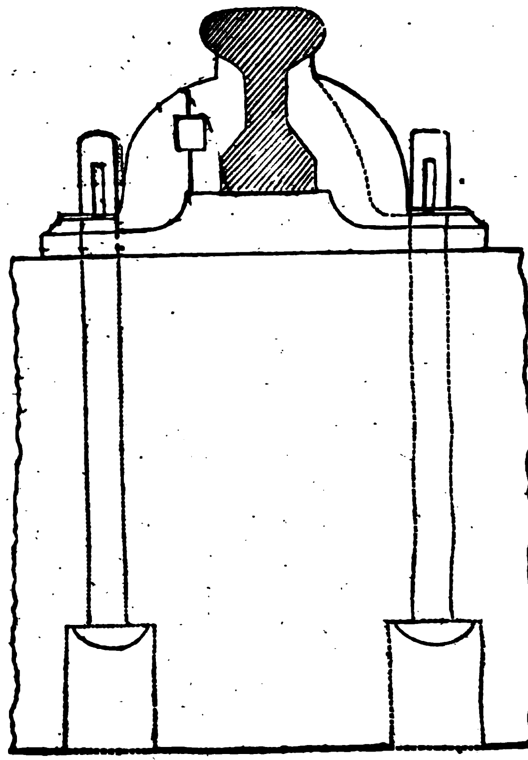
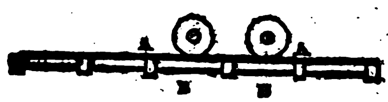


Fig. 4.



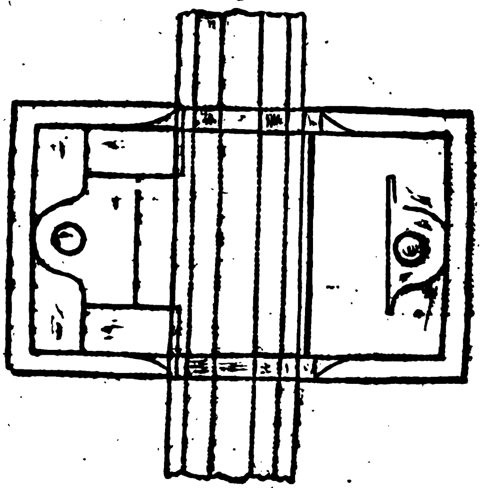
allowed to rise, which they will of course do if the end-pedestals are merely nailed down in the bad and ineffectual manner hitherto usual, namely, by common rails or spikes. When the rails are kept firmly down by proper means, the intermediate pedestals become so many fulcrums, and the tension of the fibres of the upper parts of the rail is called into play, as will be readily understood from inspection of the following diagram, in which AA represent the points of tension, and BB the points of deflection.



I perceive further from Mr. Barlow's experiments, that he considers the best rail for strength ought to be from $4\frac{1}{4}$ to $4\frac{1}{2}$ inches deep, from the upper to the lower surface. I am quite confident, however, that it will be found that the best form of wrought iron rail ought not to exceed $3\frac{3}{4}$ inches deep, or 4 inches at most; for by making the rail higher, not only will the pedestal be much weakened, but there will be no possibility of holding the pedestals firm on their base, by cotter bolts or any thing else, more particularly at the shunts and curvatures of the line of railway, and even the stone blocks will be continually shaken. It is well known in practice, that the lower any rail and pedestal can be kept, the less is the destruction in them, and the less the action on the foundation upon which the stone blocks are placed. It is also equally well known, that a sufficient wrought iron rail can be made of the depth I have stated, (namely $3\frac{3}{4}$ or 4 inches,) to resist the action of a locomotive of 12 to 14 tons weight, at a speed of 40 or 50 miles per hour, (or even more if necessary,) if it is properly laid and adjusted.

I find that the different railway companies are now going to have their rails manufactured to weigh as much as 60 lbs. per single yard. The additional 10 lbs. per yard ought, in my humble judgment, to be employed partly to strengthen the lower edge, and make it to rest more firmly on its basis, and partly to increase the width of the upper surface; both in the manner shown in fig. 6, which is a sectional view of what I con-

Fig. 5.



sider the best form of a rail of this weight. My object in these modifications is to increase the adhesion of the locomotive engines, as well as to give a little more bearing on the peripheries of their wheels, in order to make them last longer.

I understand the Directors of the Birmingham and Liverpool Railway (the Grand Junction,) have recently given an order for one or two thousand tons of parallel rails, the upper and lower edges of which are both alike; and that they have been induced to give this form of rail a trial by certain persons in their employment, who lay claim to it as *an invention of their own*, and put it off (naturally enough) as superior to all others. Now, the fact is, that twelvemonths ago, I gave one of their engineers a set of drawings, of rails and pedestals, of a variety of forms, *and this was one of them*. And in my letter to the Directors of the London and Birmingham Railway, before quoted from, I also expressly made mention of this form of rail, as one that *might* be employed, but pointed out, at the same time, certain objections to its use, which restrained me from proposing it for adoption. My words were these:

"I have hesitated with myself, whether or not to make a pattern with the upper and lower edges exactly alike, so as to be able to use either side, in case the former should prove a little unsound in any part, which has hitherto been frequently the case, especially at the ends, as I am fully aware that the more metallic material that can be brought to the lower side adds considerable strength to the rails; but as you seem disposed not to exceed 50 lbs. per single yard, a little would be lost in the depth and height of the rail. Allow me to assure you, that no public railway company will ever regret having sufficient strength in the rails at the beginning, and that they ought not, by any means, to confine themselves to a pound or two in the yard, in order to make the work as complete and substantial as possible at the commencement. But, as it is, after mature consideration, and taking every thing into question, I prefer the models I have furnished, (Nos. 8 and 3,) as the keys will be more effectual."

Fig. 8.

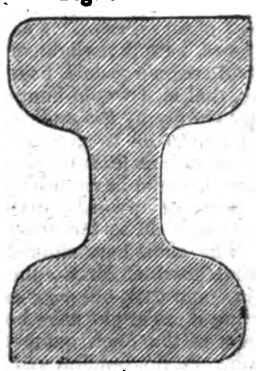


Fig. 8 is a section of the form of rail that I recommended, and would still recommend, for adoption, where it is desired to construct it, so that it may be inverted if necessary. It is what I call a "fancy rail," but ought to weigh at least 55 lbs. per yard.

Where a railway is intended for locomotive engines of only from eight to ten tons weight, a rail of the form represented in fig.

Fig. 9.

9, and weighing only 45 lbs. per yard, will be found to answer sufficiently well.

For America, where they have great difficulty in obtaining stone blocks, and are in the custom of fixing their rails on wooden sleepers of lengths varying from 30 to 50 feet, secured by cross sleepers, the best form of rail is that shown in fig. 7. I have been informed by American engineers that they can get plenty of a hard durable timber, very suitable for the purpose, for little more than the expense of cutting it down in the forests, and sending it to the saw mills to be cut into scantlings fit for immediate use; and that a railway bed of this description will last for nearly twenty years. Sometimes they lay their rails on cross sleepers only, dispensing with the side pieces. Several orders for rails of the form above referred to are now executing under my inspection for railway companies in America.

But to return to our own country: Mr. Barlow, I observe, says, "For the intermediate chairs, I think a slight modification of Mr. Stephenson's would best answer the purpose, that is, I would support the rail in the chair simply by the ends of two plain-ended pins, so as to give it the requisite steadiness with as little friction as possible. Of course I would have these pins pointing horizontally, or upwards, instead of downwards, as they do in the chair in the question." The chair here alluded to is, I presume, that for which Mr. Stephenson, *junior*, some time ago took out a *patent*, instead of submitting it, as might have been expected, to the test of the open competition, which his employers, the London and Birmingham Railway Directors, thought best for the interests of the public. As I have not myself seen any drawing or description of this chair, I am not prepared to offer any decided opinion upon it; but if its excellence consists (as Mr. B.'s language seems to indicate,) in supporting the rail "simply by the ends of two plain-ended pins," it must be one of the most inefficient of all the contrivances ever designed for the purpose. Mr. B. might as well make use of two of his fingers, as two such "plain-ended pins;" for after a locomotive engine had passed once or twice over them, they would be (not crushed, perhaps,) but rendered of no manner of use whatever.

Mr. Barlow says in a note to the passage last quoted, "It may be worth consideration, whether if this mode of fixing were adopted, it would not be practicable and advantageous to introduce pieces of felt, or other substance, within the seat of the chair, which would greatly subdue the jars that take place between metal and metal."

A crowning instance this, of the little practical acquaintance Mr. Barlow has with the subject about which he has written so learnedly. I have said that he might as well make use of two of his fingers as two of Mr. Stephenson, Jun.'s pins (if Mr. Stephenson's they be); and so I now take leave to tell him that as far as any benefit is to be derived from the insertion of felt within the chair, he might as well insert a piece of his thumbskin.

I will only, Mr. Editor, trespass further on your valuable space, to make another brief extract from my letter to the London and Birmingham Railway Directors, which contains a suggestion for the further security of the rails, that seems to me not undeserving of general attention:

"I should also advise, that each joint-pedestal should be coupled with the opposite one by an extended round bar of three-*fourths* or seven-eighths diameter, with a washer welded on each end, so as to drop on the ends of the copper bolts in order to keep the railway in true gauge. This I have found of great service even on common railways."

Trusting to the interest and importance of the subject for a justification of the length to which this letter has extended,

I remain, dear Sir, yours, respectfully,

Robert Daglish.

Orrell Cottage, near Wigan, May 26, 1835.

Science in Russia. — An uncommon effort is now making in Russia, to promote a knowledge of the natural sciences. This is the most extraordinary, when it is recollected that the imperial government has exercised an unparalleled hostility towards the only two universities of distinction in poor, degraded, miserable Poland, the victim of the most disgraceful barbarities that were ever practised in a civilized age. M. M. Push and Zeuscher, the professors of geology, whose high attainments would confer honor on any country, have been dismissed, and the cabinet of the former sold in Russia, in order to prevent the pos

sibility of having the higher departments of useful knowledge taught in territorial Poland.

At Irkutsk, in Siberia, that remote section of the world, where nature scarcely tolerates the existence of animal life, there is a gymnasium, which is furnished with an excellent library, and collections of minerals, rocks and shells, of great value. Count Cancrin, a philosopher as well as minister of state, has been a principal mover in the laudable efforts to enlighten his rough countrymen in the beautiful and sublime science of nature. Even Nicholas, intent as he seems to be in fettering the minds, limbs and property of his fifty-five millions of subjects, has sanctioned, since 1833, eight expeditions, of moment to the learned in all countries. Four of them were explorations of the Ural mountains, for the express purpose of obtaining a complete geological map of that singular and truly terrific region. North of these mountains, in the Trans-Caucasian district, where the auriferous sand, Glauber's salts, and volcanic soils, are predominant, the Russians have made themselves familiar with all the products which are regarded as important, by chemists or geologists.—[Scientific Tracts.]

Heat.—For a long time, philosophers have supposed that meteoric iron is made hot while traversing the atmosphere. A curious experiment was resorted to by M. Bierley, a foreigner, within a few months, which may possibly be of some service to those engaged in similar pursuits. A bar of iron, heated to whiteness, was held against a strong current of air from the blowing apparatus of a forge. Singular as it may seem, the bar, instead of cooling, burned very brilliantly, throwing off scintillations in every direction. The temperature rather increased than diminished. This experiment makes it very certain that a metallic mass, whirled through the upper regions of the air, would become extremely hot and eventually sparkle, as many meteors do just before they fall.—[Ib.]

Shooting Stars.—From the Transactions of the Geological Society of France, we learn that Professor Gruithuison is engaged in solving the problem of the true origin of aerolites and shooting stars. It is said, but on what authority is unknown to us, that he has proved, by mathematical calculations, founded upon physics, that those bodies must all be formed entirely above, and therefore beyond the earth's atmosphere, in space which astronomers technically call *interplanetary*, where the metals and metalloids are supposed to be held in solution by means of hydrogen, and where they exist continually for the formation of those singular opaque bodies.

Herschel was of opinion that shooting stars might be studied with reference to determining longitude. M. Quetelet estimated the meteors seen by himself to be between ten and fifteen leagues from the earth, and their motion at the rate of from five to eight leagues in a second of time. Several of the German philosophers have come to similar conclusions. The doctrine may, therefore, be considered as established, by the best of all evidence, that shooting stars traverse through an immense distance of celestial space, before they arrive near enough to terra firma, to be recognized by the eye, even at the moment their brightness is rapidly dissipating.—[Ib.]

South Sea Island Tides.—Sir Isaac Newton's theory of the tides seems to be of little or no service in explaining the phenomena of high and low water in Polynesia. A host of evidence has been collected, establishing, beyond all manner of doubt, the fact that the tides at the South Sea Islands are scarcely any, if at all, influenced by the moon. The water rarely rises more than a few inches at any season of the year; and an unusually high tide at no time exceeds an elevation of one foot. But the most extraordinary circumstance in connection with these phenomena is this: during the whole year, without regard to the moon, it is invariably low tide at six o'clock in the morning, full tide exactly at noon day, and low water again at six in the evening. The true time is established and known altogether by the flowing of the water, at the islands. It has been suggested that this may be accounted for by supposing a suspension of the lunar tide-wave in the region where these beautiful, paradisaical abodes of once unsophisticated human nature are located.—[Ib.]

The Volcano of Popocatepetl.—M. de Gerotty, accompanied by two scientific companions, the last season, made an ascent of this very celebrated volcano, at the top of a huge mountain ridge, which bounds the great valley of Mexico, on the south and south-east. On this ridge, there are, in fact, two volcanoes, but the second, Iztaciuhatl, has not attained so much celebrity as the one under consideration, known by its Indian name of Popocatepetl. The crater, according to the account of our explorers, who have written a minute description to Baron Gross, chief secretary of the French Legation in Mexico, is an mmense abyss, nearly round, bulging towards the north, nearly a league in circumference;

and from eight hundred to a thousand feet in perpendicular depth. The bottom of this awful furnace, as well as the inclined plane of its sides, is covered by innumerable blocks of pure sulphur. From the centre, masses of white vapor ascend with great force, but are dissipated about half way up the funnel. It was on this elevated summit, eighteen thousand feet above the level of the sea, that Don Diego Ordaz, one of the officers of Cortez, procured sulphur for manufacturing the powder used in the conquest of Mexico.—[Ib.]

VOLUMESCOPE.—Professor Hare, a celebrated chemist of Philadelphia, has invented an excellent instrument with the above name, which promises to be useful in the laboratory of every person devoted to chemical investigations. This instrument purports to be particularly for the analysis of atmospheric air, by means of nitric acid. He has also contrived an apparatus for obtaining the nitrogen from atmospheric air. It is truly delightful to hear that any thing is done in America to keep alive chemistry.—[Ib.]

LAUGHING HYENA. — The laugh of the hyena greatly resembles that of a maniac, and has a sterling effect as it steals through the still night, even under our windows, which it approaches in search of food. The power of imitation given to these animals is very extraordinary; for they not only cry like the quadruped whom they wish to lure within their reach, but they even seem to utter human sounds. The commandant of a fortress on the western coast of Africa assured a lady, that for several evenings he had been disturbed at his dinner hour, by the laughing and screaming of the native women, who passed under the walls in search of water. He sent his serjeant to them, who desired that they might take some other path, and they promised to obey. The next evening, however, the noise was heard again, which highly irritated the commandant, and he desired the serjeant to lie in ambush on the third evening, and rushing suddenly out on them, with a few soldiers, secure the women, and bring them to him in the fortress. The men took their station as ordered, the laughing recommenced, and out they sallied, when, to their great astonishment, they only saw three hyenas standing in the path which had been frequented by the women, and so well counterfeiting their voices, that they could not have been detected but by sight. These hyenas are not very formidable, and will, at any time, rather fly from, than attack a human being.

This species of the hyena are very common in American menageries, but they are so subdued and powerless, from constant confinement, and so fearfully watchful of the keeper's eye, that they never manifest, as prisoners, any of the peculiar imitative sounds which characterize them in their native regions.—[Ib.]

Report to the Board of Directors of Bridges, Public Roads, and Mines, upon the Use of Heated Air in the Iron Works of Scotland and England. By M. DUFRENOY, *Engineer of Mines. Paris,* 1834.

(Continued from page 44.)

REMARKS UPON THE NATURE OF THE COAL EMPLOYED IN THE FURNACES USING CRUDE COAL.

It results from the preceding description, that certain coals, those of Wales, are employed in their natural state, for the fusion of iron ore in the smelting furnaces in which combustion is sustained by cold air.

That a great number of others — the coals of Glasgow, for example—are also susceptible of being used in the crude state, when the hot blast is employed; but that, for some varieties, the transformation into coke appears still to be indispensable, whatever be the plan on which the iron is made. To appreciate the causes which produce these remarkable differences in the properties of these coals, I have collected samples of most of those employed in the works spoken of in this report, which M. Berthier has analyzed in the laboratory of the School of Mines, and the results of which he has communicated.

Coal employed in the crude state in the Welsh Iron Works. Cold Blast.

	Dowlais.	Cyfartha.	Pen-y-darran.
Carbon,	0.795	0.784	0.768
Ashes,	0.030	0.028	0.032
Volatile matters,	0.175	0.188	0.200
	1.000	1.000	1.000

The coal of Dowlais is lamellar, separating across the layers in smooth and brilliant plates. This coal is composed of two distinct parts, one brilliant, dividing into small cubic fragments; the other, completely hard, fracture conchoidal, is nearly analogous to the Cannel coal.

These two varieties do not blend, but form in each strata small beds of greater or less thickness; the brilliant part greatly predominates. The Dowlais does not soil the fingers; it swells very little in coking, and does not cake; the ashes are perfectly white.

The *coal of Cyfartha* is rather slaty, or

lamellar, but is composed, as the preceding, of the union of the brilliant and compact black parts, intimately mixed, like the quartz and feldspar crystals in granite.

These two varieties of coal act very differently; that having a brilliant fracture, swells and cakes sufficiently, whilst the dull kind is dry, and does not change by exposure to the fire. It is probably this mixture that gives to the coal employed at the Cyfartha works the property of resisting more than any other the action of the blast, and the different movements which take place in the furnace; its friability is also due to this circumstance; but the bitumen, which exists in sufficient abundance in the shining coal, cements the different parts of this coal, and gives it a great solidity after having been exposed to the fire.

The *coal of Pen-y-danau* has the same properties as the preceding, except that the mixture of the two kinds is less intimate. These three coals, belonging to the coal basin of Wales, are very dry, and owe this property to the excess of carbon which they contain; they are analogous to the coal of Rolduc.

Coals employed in a crude state in Furnaces worked with Heated Air.

		Environs of Glasgow.			Staffordshire.	Derbyshire	
		Clyde.	Calder.	Monkland	Tipton near Wed'y	Butterly.	Codnor Park
Carbon,		0.644	0.510	0.562	0 675	0.570	0.515
Ashes,		0.046	0.040	0.014	0.027	0.030	0.030
Volatile matters,	Water,	0.005	0.039	0.115	0.300	0.400	0.455
	Gas,	0.139	0.081	0.094			
	Tar,	0.166	0.330	0.215			
		1.000	1.000	1.000	1.000	1 000	1.000

The *coal of the environs of Glasgow*, employed in the Clyde, the Calder, and the Monkland works, present characters sufficiently marked, and of a composition very analogous, as seen by the preceding table.

This coal is usually dull, a little compact, hard, and does not crumble between the fingers; it presents, in its transverse fracture, a series of small lines, which gives a slaty appearance, though it does not, in reality, possess this quality. It is very well stratified, and the lumps cleave in flat fragments, of greater or less thickness; the surfaces of separation are almost always marked by black carbonaceous matter, which soils the fingers, and resembles charcoal in its fibrous appearance and dull color.

This coal is often traversed by extremely thin fillets of carbonate of lime, the direction of which is perpendicular to the layers, and sometimes pyrites is found.

The pieces of Glasgow coal submitted to analysis, softened but slightly; they cement together without change of form.

The *coal of Tipton*, which supplies the works of Lloyd & Forster, near Wednesbury, is slaty; it is composed of small beds, a few lines in thickness, separated almost always by an extremely thin bed of black carbonaceous matter, like charcoal. This substance is so abundant, that a piece of coal is rarely found at Tipton more than four inches thick, which does not present one or two layers of this friable material. This coal, shining in its fracture, divides into small pseudoregular fragments; it is slightly tenacious, and swells but little in coking.

The *coals in the environs of Derby* are divided into two principal qualities, designated under the names of *Cherry coal*, and *Soft coal;* the first, which is the harder, resists the action of the fire better than the second. The furnaces of Butterly, which use heated air, consume the Cherry coal exclusively; this coal is slaty, and presents lines of dull black, which gives it a strong resemblance to the coals of Scotland.

The soft coals, employed principally for steam engines and puddling furnaces, are used also, at Codnor Park, for the roasting of ores. This coal is shining, slaty, and separates in pieces by very light pressure; it contains some thin portions of black and friable carbonaceous matter, already alluded to.

Notwithstanding the considerable loss which these two coals sustain by coking, they scarcely change their form; they swell and cake slightly, and their ashes are perfectly white.

Coals that appear to require transformation into Coke, when employed even in Furnaces worked with Heated Air.

	Birtly Works, near Newcastle.	Tyne Works, Northumberland	Apdale Works, near Newcastle, Staff'dshire.
Carbon,	0.605	0.675	0.624
Ashes,	0.040	0 025	0 035
Volatile matters,	0.355	0.300	0.341
	1.000	1.000	1 000

The coal consumed at the Birtly and the Tyne Iron Works comes from the mines in the environs of Newcastle-upon-Tyne; it is shining, and splintery; it does not soil the fingers, nor does it crush by a light pressure.

This coal is, in general, very pure, containing no veins of carbonate of lime, or pyrites; it is very adhesive, and swells much by the action of heat, so that the value of the coke exceeds that of the coal employed. I am assured at the Tyne Works,

that they have tried in vain to work Newcastle coal in the crude state.

The coal of the *Apdale Works* is lamellar, shining and splintering in the direction of the strata; it divides into small quadrangular fragments; in the cross fracture, it presents large bands, perfectly smooth, and very brilliant. This is owing to the superposition of small layers, of which the nature is a little different; this coal is very adhesive, swells in the fire, and gives a light, silvery, but very solid, coke.

If we compare the composition of the different coals that we have examined, we perceive—

1st. That the coals employed in a crude state, in the furnaces worked with cold air, are dry, very carbonaceous, and, in fact, true anthracites.

2d. The coals, as those of Scotland and Derbyshire, which, though bituminous, serve, in a crude state, for the fusion of iron ore in the smelting furnaces worked with heated air, are, however, still dry coals.

3d. Finally, the fat, bituminous, adhesive coals, which change their volume, and swell by the action of fire, appear still to require a transformation into coke, to give advantageous results in the smelting of iron ore.

QUALITY OF THE PIG IRON AND BAR IRON OBTAINED IN THE WORKS USING THE HEATED AIR BLAST.

The iron for castings in Scotland bears a less commercial value than that of Staffordshire. The first were quoted in the Liverpool market, in the month of July (1833) last, at 4*l.* 15*s.* sterling per ton, whilst the Staffordshire iron sold, at the same time, for 6*l.*

The difference between the price of these kinds, together with the prejudice generally entertained that the hot blast is unfit for the manufacture of iron, led some to doubt the advantages to be derived from the new method. The numerous observations I have made, tend, on the contrary, to prove that, for cast iron, at least, the products of the furnace working with heated air are superior to those of the cold blast. The less value of the Scotch iron is no evidence against this opinion. In fact, the Staffordshire iron has always been regarded as the most suitable for castings, and has always borne a higher price than that from most of the other parts of Great Britain; perhaps, also, the great difference in price between the Scotch and Staffordshire irons may be accounted for by commercial circumstances, for the Scotch now make iron much cheaper than others, and the production being increased almost one-third, by the employment of heated air alone, the iron masters have thought it to their interest to reduce the price of their iron, which they are enabled to do without loss.

It would be desirable if this important question could be decided by direct experiments; but for want of such, I will state the uses of these different products in the arts—uses which are, perhaps, as conclusive as experiments.

In the works near Glasgow, they make iron only for the foundry; I have seen the iron which they produce employed for the manufacture of castings, which require great strength and softness, to wit: steam engine cylinders, boilers, gas pipes, mill gearing, &c.

At Birtly, near Newcastle, and at Butterly, near Derby, I have also seen steam engine cylinders, pipes for water pumps, and fastenings for iron bridges.

I should state that the furnace of *Torteron*, at the Fourchambault works, in the Nievre, produces, since the use of this plan, gray iron, which competes in the market with that from England.

The iron manufactured from hot blast pigs is also of very good quality.

At Codner Park, near Derby, this iron is employed in the constitution of different parts of the steam engine, of chains for suspension bridges, and of straps and cross-bars in iron bridges.

The iron produced at the Tyne works is wrought into sheets, for steam boilers, gasometers, &c.

At Wednesbury, the iron is also of good quality, and serves for purposes which require great strength.

These different examples prove that, by means of the hot blast plan, as well as by the old mode, superior metal can be made for foundry purposes, and which is well adapted for conversion into wrought iron; but it must not be thought that, by means of this plan, the faults which result from the nature of the ore, or coal, can be corrected.

PROBABLE CAUSES OF THE INCREASE OF HEAT, DUE TO THE USE OF HEATED AIR.

I have remarked several times, in the course of this report, that the temperature of the furnaces worked with heated air appears to be higher than in those where combustion is sustained by the use of cold air; all the indications which are usually considered as guides for the working of the furnace, unite in proving this assertion.

The scoria does not attach itself above the tuyeres; the color of the fire, in this part of the furnace, is so white as to be injurious to the eyes; the scorias, which are very liquid, flow with facility; the metal being hotter, can be cast directly into the most delicate objects. The quantity of ore

in each charge is augmented in a great proportion, whilst the quantity of flux is decreased. This diminution in the proportion of melting is, of itself, the strongest proof of the increased temperature of the furnace; it indicates to us that the earthy matters find sufficient heat to fuse with a small addition of flux.

Probably it is to this excess of temperature that we should attribute the faculty of employing certain coals in a crude state, the transformation of which into coke appeared indispensable, at a less elevation of temperature.

In spite of these certain proofs of the increased temperature by the introduction of hot air into the furnaces, we cannot demonstrate its existence in a positive manner; but it appears to me that, to a certain point, a reason for this phenomenon may be given, by comparing that which passes in the furnace, by the constant introduction of air, to that which takes place by the mixture of two liquors of different temperatures, which we know will produce a mean temperature. The comparisons which I establish appear to me to be just, though the furnaces are in circumstances very different from the liquids having a given temperature, because the heat is reproduced without intermixture, by the combination of carbon and oxygen.

By admitting this cause of the augmentation of heat, it might be supposed to be very slight; on account of the great difference which exists between the temperature of the furnace, and that of the air which sustains the combustion; a difference that we have no accurate means of appreciating. I will show hereafter that this cause is not so feeble as might at first be supposed.

There is, I believe, another much more powerful cause, which it is impossible to estimate; it results from combinations, which could not be produced at the ordinary temperature of the furnace, and which are developed by the augmentation of heat due to the substitution of hot for cold air.

We see constantly, in our laboratories, examples of this phenomenon; substances which are acted upon slowly, and with much difficulty, by acids, at the temperature of the atmosphere, dissolved with facility when the liquor is slightly heated, and the combination formed often becomes itself a powerful source of heat. The operation of the smelting furnaces presents to us, perhaps, similar circumstances. The bitumen, and certain gases, which cannot burn at the temperature of the furnace using cold air, becomes ignited by the feeble augmentation of heat produced by the introduction of heated air; and the little smoke which passes out from the tunnel head when crude coal is consumed, and also the color of the flame, authorizes the belief that the bitumen, the hydrogen gas, &c., are almost wholly consumed.

This supposition naturally answers the objection that may be made, that, even admitting a certain augmentation of temperature by the introduction of heated air, there can be no diminution in the quantity of fuel consumed, because the diminished amount of fuel used in the furnace is compensated for by that required to heat the air.

We have stated that the quantity of air injected into the furnace could, by its great mass, have the power of cooling it to a considerable degree.

This mass of air was raised in the Scotch works, before the adoption of the hot air plan, to 2800 cubic feet per minute, weighing 214¼ pounds. The quantity of air injected in each day, therefore, may be estimated at about 140 tons.

The total amount of coal, mineral, and flux, does not exceed thirty-four tons; the weight of air, therefore, injected into the furnace, is more than four times that of the solid materials used in the same time.

We may conceive, therefore, that so considerable a mass, of which only a fifth part sustains combustion, thrown into the furnace at the mean temperature of the atmosphere, will produce a much greater refrigeration than when raised to the temperature of more than 600 degrees.

A circumstance which still tends to diminish, in a great degree, the refrigerating power of the air, by the use of the new plan, is, that the quantity of air is much less. In the furnaces of Scotland that we have taken for example, the quantity is reduced from 2800 cubic feet, to 2100 per minute, or twenty-five per cent.*

We can calculate the influence of the introduction of air upon the heat developed

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* The specific heat of water being represented by 1.0000, that of the atmospheric air is 0.2669, from which it results that a gramme of air at 322° Cent., (612° Fah.) the temperature at which the air is injected into the Clyde furnace, would raise 0.733 gms. of water to 100°, (212° F.) supposing the air reduced to 10°, (60°;) and as the quantity of air introduced each minute is 124,770 gms., the heat which results from this mass is represented by 01,463 gms. of water, raised to 100°.

The charges at the Clyde works are now 34,416 kilogrammes of coal in twenty-four hours, or 23.00 kil. per minute, which, after deducting the waste by ashes, water, and gas, which escapes without being burnt, may be taken at a maximum of 20.30 kil.; the complete combustion of this quantity of coal would raise, in each minute, 1,465 kil. of water, from 0 to 100° centigrade; the increase of temperature which results from the temperature of the air at 322° cent., compared with that produced by the combustion of coal, would be as 92 to 1465, or one-sixteenth. This is the least ratio, the quantity of oxygen being insufficient to transform all the carbon into carbonic acid.

each instant, by the combustion of carbon; but it appears impossible to appreciate the augmentation which results from new combinations, caused by the combustion of the bitumen and carburetted gases, because we cannot, in the present state of the science, estimate the temperature in the interior of the furnace; the few observations that precede, though not giving any idea of the real influence of the heated air, appear to me, at least, to establish that it is very considerable.

RECAPITULATION.

The details into which I have entered upon the greater part of the works using heated air, have, perhaps, prevented the reader from seizing the principal circumstances of the plan; I deem it, therefore, useful to recapitulate briefly—

I. In all the works, with the exception of one or two, its introduction has resulted in an increase of the products, an economy in the consumption of fuel, and of flux, as well as in the expense of labor, and incidentals.

II. These advantages have followed in the same progressive ratio as the temperature to which the air has been heated.

III. The production of metal has generally increased.

IV. The quantity of combustible matters burnt in the furnaces appears to be nearly the same where the heated air is used, as before with cold air; the daily consumption at the Clyde being eighteen tons of coke, to obtain six tons of metal; now it is eighteen tons of coal, to produce nine tons of metal.

V. The metal produced in the furnaces worked with heated air is generally gray, and fit for the foundry; nevertheless, this plan is employed with advantage in the works of which the pig iron is all, or in part, manufactured into bar iron, (Codnor Park, Tyne, Wednesbury, &c.) It is only necessary, for this purpose, to change the proportions of ore and fuel.

VI. In many works, the combustion requires much less heated, than it did cold, air; at the Clyde, for example, the same blast engine which served with difficulty for three furnaces, now blows four. The economy in motive force is not proportional to the diminished quantity of the blast, because a certain power is required to overcome the friction of the air in the heating apparatus, and the resistance which results from the expansion of the air by the heat. This last inconvenience is remedied by increasing the size of the tuyeres, their diameter having been increased from two and a half to three inches; the increased diameter of the tuyeres is also necessary to diminish the velocity of the current of air, when introduced into the furnace.

VII. When, as at Torteron, a diminution in the quantity of air does not result from increasing the temperature, additional power is required to move the blowing machine.

VIII. The substitution of heated for cold air, in the fusion of iron ore, is marked almost immediately by a change in the nature of the metal, which becomes more carbonized; the charges descend more slowly, but the working is accelerated by augmenting the proportion of ore.

Relative to the Apparatus:

IX. The apparatus formed by joining pipes of large diameter, which receive the air, and of small pipes, in which it is heated, and dilated, appears to me to be preferable to that composed of a series of pipes, of great diameter; requiring a smaller space, being less costly in the construction, and consuming less fuel than the last named; besides, the temperature is not uniform in all parts of this apparatus, and a current is usually formed in the centre, of diminished temperature.

X. To diminish, as much as possible, the velocity of the air submitted to the action of the heat, and to avoid the resistance due to its expansion, it is necessary that the surface of the small pipes should be more extended than that of the large pipe which receives the air from the blowing machine.

XI. The interior capacity of the small tubes ought to be greater than the volume of air injected into the furnace; by this disposition, the air remains a longer time exposed to the action of heat, and acquires a more elevated temperature.

XII. From this last condition, the apparatus placed on the trunnel head appears to be of but little advantage to furnaces using coal; sufficient size cannot be given to it, to enable the air to remain long enough; to remedy this evil, the air is made to pass over another fire placed near the tuyere.

Relative to the Fuel:

XIII. The coals, very rich in coke, which are dry, and resemble anthracite, can be employed in a crude state, in furnaces working even with cold air.

XIV. The coals which contain a large proportion of volatile matters, (30 to 35 per 100,) but which are not very adhesive, and do not change form during combustion, serve, without being carbonized, to work in furnaces using air heated to 300° Cent.

XV. It appears, finally, that fat and bituminous coals, like those of Newcastle, which are fit for the fusion of iron, must, even with the hot blast, be transformed into coke.

[From the Scientific Tracts.]

HOOP SNAKE.—The writer of the following article will please accept our thanks. It is by the accumulation of facts, however tri-

vial they may sometimes appear, that any permanent advancement can be made in natural history.

Brainerd, (Tenn.) July 8, 1835.

Dr. Smith—Sir: While looking over the tenth number of the third volume of the Scientific Tracts, I noticed a request for information respecting the 'horned serpent,' which, from the short description given, I presume is the same as what is called here the 'hoop snake.' While residing in New-England, I frequently heard marvellous accounts of this snake, as existing at the south and west, but was led to consider the account as fabulous, until recently. Two years since, at Haweis, then a missionary station, about fifty miles south of this place, on the Coosa river, occupied by Dr. Butler's family, where a school was in operation, while the children were out at play, at the foot of Turnip Mountain, some of the large girls discovered a snake making its way towards them, having the motion of a rolling hoop. They succeeded in killing it, and carried it to the house. Rev. Mr. Chamberlin, who was there, and Dr. Butler, on hearing the children say that it *rolled* after them, immediately concluded that it must be the hoop snake, and were led to make an examination. They easily discovered a sting in the end of the tail, about the size of a fine sewing needle, which, when the tail was pressed horizontally, would protrude itself about three fourths of an inch. The length of the snake was supposed to be eighteen inches. It was tolerably thick; its color, dark striped. Dr. Butler preserved about four inches of the tail in spirits, and took it to New-York last summer, from whence it was to be sent to Rev. David Green, at the Missionary Rooms, Boston, where, if it has been received, you will be able to examine for yourself.

The Cherokees say that the horned snake exists in the country, but is very rare, and is considered quite poisonous. While Dr. Butler was preparing the tail for preservation, he felt a severe nausea, which continued for some time. He considers his sickness occasioned by the influence of the poison from the snake.

Should you be able to examine the tail, and think that any thing I have written is worth publishing, it is at your service.

Respectfully yours,

J. C. Ellsworth.

African Serpents.—I never shall forget, (says Mrs. Lee, who has resided a long time in Africa,) the cold chill which crept over me, on first seeing a huge lizard crawling on the wall of my bed room; yet in time I not only was amused by the rapid movements of the large lizards, as they chased each other up and down the verandah where I sat, but I even fed them daily. A snake close to me, I thought would be death; but at last I became so careless about them, that, although there was a nest of deadly snakes in a hole in the wall, which it was necessary to pass, in going the shortest way to the kitchen, I used to watch for a minute or two, and then dart past, when they drew their heads in: a dangerous experiment, for they are very fierce when they have young ones. A battle between a snake and a rat was a curious sight, to which we were summoned by hearing, in the hall above the store room, a hissing and squeaking, for which we could not account. On opening the store room to ascertain the cause, a snake was to be seen rearing its beautiful many-colored neck and head, while a rat's black eyes were glistening with rage. They were in too great a fury to be disturbed by our approach, and flew at each other several times; at length the rat died in great agony, swelled up to a frightful size, and covered with foam. The snake was immediately destroyed by the servants.—[Ibid.]

The following excellent article on Female Education is from the "American Annals of Education"; and, although it is not addressed to "Apprentices," it may be of use to them to know how to select—for most of you will probably desire to select, when in a situation, a companion for life.

A *mechanic*, above *all other* men, ought to have an industrious, prudent, and economical wife—she should not only know how to govern her family, but also to govern *herself*. She, above all women, should feel and know that *home*, rather than the *streets* and *neighbors*, is *her proper place*. If therefore you would have such a companion, seek *not* for her where the mother is a *fashionable*, or one who spends more time *from*, than *at*, home.

FEMALE EDUCATION.

Domestic Habits.—In advising as to the course of early female education, I have insisted on the necessity of cultivating, in childhood, the habits of Temperance, Order, Activity, Industry, and Self-command, as essential to the health, happiness, and usefulness of woman.

There is another branch of female education of the first importance which involves many particulars, but may be termed the *preparation for domestic life*. This involves both *habit and skill in domestic employments*.

We must begin with forming domestic habits. No quality is more essential to the dignity of the female character; and without it there will never be patience in the acquisition of *domestic skill.* On the other hand, the domestic disposition is best cultivated by giving domestic employments. Useless objects and occupations soon tire us. Splendid furniture and ornaments, and mere amusements, produce a weariness, from which there is no escape, but by perpetual change. On this plan, how many families are made, not automatons, unfortunately, but *locomotives*, active only in vain and mischievous efforts for "some new things." As capable of happiness as their neighbors, they have never learned the true mode of enjoying it. They promenade the streets; they wander from shop to shop, from house to house, from street to street, gathering every subject for vanity or trifling, every secret or witticism, or report, they can find, to enlarge their supply of occupation for idle hours. Such "busy-bodies" always leave their own duties undone, or ill-done; and the habit of neglecting their own concerns necessarily leads them to occupy themselves with the affairs of others, and to interrupt them in their occupations, or interfere with their peace.

Let the daughter then be guarded against this pernicious fault. Let her be trained to feel, that her *first great duty*, when not engaged in the acquisition of useful knowledge, *is at home*—that she is her mother's natural assistant or substitute, in the care of the nursery, and the family. When she has well-learned the lesson of obedience and self-command, she may safely be entrusted with the direction of the other children, but not till then. Under the direction of her mother, she may, in this way, complete her course of training in self-government, and learn to imitate her heavenly father, who is "kind even to the evil and unthankful."

But she must also learn in the nursery that peculiar duty of woman,—the care of the feeble and the sick. Every family, and every child, are every day liable to accident and disease. Nothing in the nursery is so important as habitual care to prevent disease, and to relieve pain, or remove the cause at once, when it occurs. More can be accomplished to secure the health of children by the faithful, interested nurse, always present, than by the absent physician, however skillful, in occasional visits, which often prove too late to remedy the evil. This office, the elder sisters, and each of them, as they grow up, should be taught and accustomed to fill. For this purpose, she must acquire, not merely skill in watching and providing for the wants of her charge: presence of mind, gentleness of disposition, combined with firmness of resolution, are indispensable to the good nurse. These must, therefore, be cultivated and matured by constant practice. Daughters who are not trained in this manner can never be safely entrusted with the health of a family. Poor and pitiable matrons—still poorer and more pitiable, their companions, and their families!

But the nursery is not the only place for domestic duties and skill. Humble as the theme is, we cannot complete our view of female education without descending to the kitchen; for the table of the king himself must be furnished from it, and even the health of the family depends upon its right management. Order, and skill, and vigilance, must begin there, or comfort can never inhabit the house. She who governs it must learn in the only way possible—by acquiring practical skill in all that is to be done. This is an every-day business, not to be accomplished by one great effort, or by some wonderful plan, but by the regular, returning care of a directing eye, and a skillful hand. The mistress of a house becomes a pitiable cypher, if she has not the practical knowledge to direct the when, and the where, and the how, of every thing that concerns her family affairs; and she can learn this only by experience. Respect is paid to authority, only when those who exert it know how to give directions in the right time, and the right manner.

Let the daughter, then, as much as possible, learn every part of household duty, practically. It was a wise step in a circle of ladies in one of our cities, to finish the education of their daughters in a cookery school. They attended punctually, and daily, for a certain number of hours, long enough to give them a competent and practical knowledge of the arts and the economy of the kitchen. Their works praised them; and the convenience and pleasure of a well regulated, economical, and healthy table was the reward of their efforts. Regularity and order prevailed in every department of the house, because the whole was directed with intelligence and skill. The incessant causes of scolding, and fretfulness, and discontent, were in a great measure removed, by the training which not only gave these matrons habits of industry and self-command for themselves, but taught them how to direct the employments of others with regularity and success.

In visiting the house of Mrs. ———, every one is ready to ask, "How could you bring your family to this regular, quiet, pleasant state?" The simple answer is, "by understanding what every one ought

to do, and how it ought to be done, by beginning right and persevering in the right course, until every one knew her duties, and could do them well." A course of actions will form a habit; and habit, we know, is second nature. In this way, hard things become easy, and labor pleasant. Idleness will be at length painful, and fretfulness intolerable. It will be easier to do right, than to resist the steady current of order in the family; and every disturber of the peace will be frowned upon, as an enemy of the whole.

And while I am urging this duty, I cannot help alluding to the sad neglect of it in modern days. What is to be the history of the rising generation? Must it be told in language like this?

"Fashion and accomplishments, and amusements, and unnecessary display in literature and science, absorbed the whole time of the females of this period. Domestic cares and virtue seem to have descended to the tomb with their grandames, or to be consigned with their pictures to the garret. Their domestic skill was lost, and their domestic habits forgotten or despised; and when the tale was told by some relic of former days, or appealed to as an example, it was only met with a suppressed smile at such antiquated notions, or an open scoff at those who busied themselves at home in ignorance, or submitted to be slaves to their husbands and children. The immediate consequences were such as might be anticipated. The wealth which industry abroad and frugality at home had accumulated, was scattered by indolence and ignorance, and prodigal expense. The noble dwellings which it had raised and furnished, were sold to pay the debts of extravagance, or pulled down to make way for others, which soon shared the same fate. Many a mechanic, who grew rich by the obsolete virtues of industry and economy, occupied the splendid house of those who looked down upon him, and despised his virtues; and his daughters held the first station in society, while those of his employer might be found in some obscure corner, with little to cover them but worn-out finery, and apparently with little to sustain them but their pride in what they had been. Nay, the domestic was often to be seen taking the place of his master, and occupying the station from which his children had fallen, by the neglect of forming domestic and industrious habits in their education."

Whether this shall be the record of the whole generation or not, such is, unhappily, the history of many a family, and is likely to be that of many more. Perhaps I shall not even obtain a hearing from those who have already begun this course. The whirlpool seldom permits any to escape who have once entered, even its margin. But those who are approaching it may, perhaps, hear me; and I warn them, that they guard against its powerful current before it is too late; for I have witnessed more examples than I can mention, of its ruinous effects.

I am aware that economy and its attendant train of minor virtues are *old fashioned* matters. They are found in here and there a family; but the very names seem rather to belong to the dictionaries of the last century. But there is a section in an old book, too seldom studied—the last counsel of a wise man—which recommends them; and as it describes particularly the virtues and the defects of women, it ought to be often read by mothers and daughters. Although not new, its very antiquity, I trust, will give it authority with most readers; and in addition to other salutary truths, they will learn that in female education, and in female duties above all things, "the fear of God is the beginning of wisdom." SENEX.

FARMERS AND MECHANICS.—Miss Sedgwick, or one of the Misses Sedgwick—for there are three of that name who have appeared in print—have just issued a new work from the press of Messrs. Monroe & Co., of Boston, entitled "Home," and dedicated to the Farmers and Mechanics. The sentiment conveyed in the following appropriate language is no less just than true. One of her characters charges her neighbor with the intention of educating his sons for the learned professions, and his daughters for the wives of professional gentlemen, to which the latter thus sensibly replies:

"I shall be governed by circumstances; I do not intend or wish, Anthon, to crowd my boys into the learned professions. If any among them have a particular talent or taste for them, they may follow them. They must decide for themselves in a matter more important to them than any one else. But my boys know that I should be mortified if they selected these professions from the vulgar notions that they were more genteel—a vulgar word that ought to be banished from the American vocabulary—more genteel than agriculture or the mechanic arts. I have labored hard to convince my boys there is nothing vulgar in the mechanic profession—no particular reason for envying the lawyer or the doctor. They, as much as the farmer and mechanic, are working men. And I should like to know what there is particularly elevating in sitting over a table and writing

prescribed forms, or in inquiring into the particulars of diseases and doling out physic for them. It is certainly a false notion in a democratic republic, that a lawyer has any higher claim to respectability—gentility, if you please—than a tanner, a goldsmith, a painter, or a builder. It is the fault of the mechanic, if he takes the place not assigned to him by the government and institutions of his country. He is of the lower orders, only when he is self-degraded by the ignorance and coarse manners which are associated with manual labor in countries where society is divided into castes, and have therefore come to be considered inseparable from it. Rely upon it, it is not so. The old barriers are down. The time has come when 'being mechanics,' we may appear on 'laboring days' as well as holidays, without the 'sign of our profession.' Talent and worth are the only eternal grounds of distinction. To these the Almighty has affixed his everlasting patent of nobility, and these it is which make bright 'the immortal names' to which our children may aspire as well as others. It will be our own fault, Anthon, if, in our land, society as well as government is not organized upon a new foundation. But we must secure, by our own efforts, the elevations that are now accessible to all."

Manual Labor Schools.—We consider the man who first introduced this important system as a public benefactor—and entitled to more credit for his services than if he had conquered a nation.

If "he who makes two ears of corn, or two blades of grass, grow where only *one* grew before, deserves better of mankind and his country, than the whole race of politicians put together," how much more does he deserve, who points out a way by which two young men, destitute of means, according to *previous* opinions and practice, can, where only *one* was before enabled to, acquire an *education*, and thereby contribute to the education of others, and to the general diffusion of knowledge?

Not that a young man is *now* enabled to do more than he could have done if he had only been so convinced of the fact; but it is by having pointed out the *method*—and by convincing young men of their *ability*, to support themselves, every day, by their own exertions, without interfering with their studies, which is so creditable to its author—as now every young man who has learned a trade may by that means readily acquire a collegiate education, by his own labor, and be none the less, but actually much more, respected for the manner of acquiring it.

Manual Labor in Waterville College.—From a recent statement by President Babcock, of Waterville College, Maine, it appears that the manual labor department of that Institution is remarkably successful.

"Considerably more than one half of the whole number of students in College are regularly engaged in labor (chiefly in the College shops) three hours a day. Their earnings vary from 50 cents to $2 50 cents per week, according to their skill, strength, and diligence; but on an average they pay for their board by their labor. This system of labor has been in successful operation for more than two years, (with the exception of a few weeks last autumn, when the scarcity of lumber partially suspended work in the shops,) and the results of it are no longer doubtful. The regular exercise thus furnished is found highly conducive to health, and to intellectual vigor. No student is hindered in the successful prosecution of his studies, by employing three hours a day in work. The good order of the College is also essentially promoted by this kind of employment of the leisure hours of so large a portion of the students."

He gives the following reasons why this plan has succeeded better there than in many other institutions.

"A large proportion of our students are able-bodied men, who have been accustomed to labor, and do not regard it as dishonorable. We have an excellent and popular superintendent of the shops, at a reasonable charge. The shops, tools, &c., have been furnished by contributions for the purpose, and only need to be kept in repair by a small tax on the occupants. We have also unusual facilities for purchasing lumber, and disposing of work of various kinds from the shops. By carrying the principles of the division of labor into effect, the several processes are so simplified, that young men, of common ingenuity, if they have never before been accustomed to the use of tools, very soon learn to work to good advantage. The low price of board and tuition (only $1 a week for the former, when paid in advance, and $20 per annum for the latter,) are an encouragement to many worthy young men, thirsting for the advantages of education, to endeavor to procure one here chiefly by their own efforts."

It is also stated that individuals of proper

age, who do not pursue the regular course, are allowed to reside in the institution, and are permitted to engage in any studies they may choose.—[Am. Annals of Education.]

Locomotive Power of Oysters. — The Abbe Dicquemere endeavored to show, and pretty satisfactorily too, that the oyster can perform various locomotive movements, perfectly corresponding to its wants, to the dangers it apprehends, and to the enemies by which it may be assailed. If an oyster is taken from a locality which is always covered by water, and placed in one where there is an ebb and flow of the tide, having had no experience on the recession of the sea, its shell is thrown open, regardless alike of the destructive tendency of solar heat or violent assaults of enemies. On the other hand, placed in a similar condition to its original abode, there seems to be a conciousness of the change, as fear induces it to press the valves closer than ever, till a familiarity is established with the condition of things in the new and unexplored region to which it has been carried. This argues an approximation to mind. Indeed, if it is not elementary intelligence, something a little beyond the mere force of instinct, what is it? There is a plain indication of both sensation and distinct perception.

Oysters are furnished with a cylindrical organ for propelling a little stream of water with considerable force. By this syringe, for in effect it is one, inasmuch as it acts upon the same principle, sea worms, gravel, and other equally offensive intruders within the shell are suddenly resisted at the margin, or washed out, if once entered, by this simple yet indispensable contrivance. By an instantaneous ejection of the contents of the tube against the water by which they are surrounded, if not firmly wedged between rocks, or to each other, they can change their position, and vary it to suit their further convenience from time to time. Thus the activity they sometimes discover in going backwards or forwards, magically as it were, there being no limb protruded by which a hold can be taken upon the bottom, wholly depends on their syringe. Any one can experiment to his own satisfaction to understand the locomotive ability of the oyster, by placing two or three of them horizontally on a plate, with just water enough to cover them.—[Scientific Tracts.]

Sand Capes.—On walking over sandy beaches in this vicinity, from the first of June till the approach of the autumnal frosts, an immense number of somewhat saucer-shaped cups of sand are found everywhere scattered, from high to low water mark, varying in size from half an inch to six or eight inches in diameter. From the circumstance that they resemble a lady's cape, as nearly as anything to which they can appropriately be likened, they have received the significant name of *sand capes*. Particles of sand, side by side, are glued together so firmly that considerable force is required to tear the broad ribbon which is presented, when the cup or cape is spread out into a flat or nearly flat surface.

The question has recently been agitated by an editor of a daily paper in Boston, who was struck with the singularity of their appearance on the famous Nantasket beach, what produces them? He seemed to suppose the sand was rolled into that particular form by the action of the waves.

Having carefully investigated the subject, we are able to solve the problem. They are the architecture of the *Natica heros*, the common cockle, or sea snail. Some are as large as a turkey's egg; and others, according to their age, are quite small. The object of these capes is protection from the solar heat, when the tide leaves the animal. It rarely happens that the snail manufactures a cape at any other time than in the forenoon, when the sun pours down its intensest heat. The snail, just under a thin covering of sand, throws out of a secreting organ, just within the gyral lip of its shell, a thick, glairy fluid, resembling the white of an egg. It then instantly begins to roll over, which spreads the gluten over its whole surface, to which the sand adheres. As the shell comes right side up, the sand cape is beautifully fabricated, and almost instantly hardens. The gluten is perfectly insoluble in water, and therefore resists, for weeks, the combined action of winds and waves, after being abandoned by the snail. Under this curious protection, the animal protrudes itself above the surface, and travels about under it in search of food. Though their progress is slow, we have seen them protrude their tentacula, fearlessly, engaged in reaching from under the edge. As soon as the tide returns, the cape being no longer necessary, it is overturned, and washes away. We saw one made, the other day, by a snail purposely exposed to the burning rays of the sun. As soon as it was completed, we took it adroitly off. The want of it was obviously felt, for another was commenced directly. We have several prisoners at this time, each one being driven to manufacture a sand cape at our pleasure.

But as nature allows nothing to be wasted, being an economist in everything, the cast off cape becomes an important auxiliary to another class of almost unnoticed aquatic beings. Shrimps, prawns, sand bugs, and

even barnacles, take possession of them, if they happen to remain any considerable length of time right side down. Being slit open upon one side, like the lip of a screw auger, these little animals slide in at the breach, and concealing themselves under the shade of the cup, there wait the entrance of still smaller creatures, on which they voraciously prey. The barnacles, particularly, stick on a vast quantity of eggs, in regular rows, which increase very rapidly, under the alternate influence of sunshine and water.

Were the glue of which we have been speaking collected in vials, an easy matter, by compressing the organ in which it is elaborated, it would be found the best article for mending glass vessels in the world. Water does not soften it, and being, probably, only soluble in high wine, it might be made an important article in domestic economy.—[Ib.]

Checks and Balances.—In the marshy sections of equatorial regions, where the jointed canes grow to an immense height, there also abounds a species of ant, that makes an entrance near the root, and gnaws its way through the whole series of joints, till it arrives at the top, where it remains till the periodical rains have subsided. Without this particular vegetable production, the ant would be drowned, as the peculiarities of its organization and construction require that it should live where stagnant waters abound. While the ants are preserved by wending their way up the hollow reeds, they cause the death of the plant, which, becoming dry, is in time overcome by the winds, decays, and thus furnishes soil for the nourishment of other plants.

This same provision is discoverable throughout the globe. Nothing is immutable. However beautiful or useful, or however complicated, nothing can remain at rest. Matter is continually and necessarily assuming new forms, and acquiring new properties. Some tribes of beings seem expressly created for the destruction of others, so that the whole physical condition of the earth is forever undergoing changes. This law contributes to the vigor, health, and utility of the whole.—[Ib.]

A Domesticated Panther.—Mrs. Lee, to whom we are indebted for many curious illustrations of the character of African animals, speaking of a domesticated panther, says:—

"He came from Coomassie with Mr. Hutchinson, the resident left there by Mr. Bowditch, and, as he was very young, the efforts made by that gentleman and others to tame him were completely necessary. Nothing alive was ever given him to eat, and so well was he trained, that frequently on their march to the coast, when the natives would not contribute any provisions, he would catch a fowl, and lay it at the feet of Mr. Hutchinson, who always rewarded him with a select morsel. On arriving at Cape Coast, he was tied up for a few days with a slight cord, and after that, remained at liberty, with a boy to watch that he did not annoy the officers of the castle. He especially attached himself to me and the governor, probably because we bestowed more caresses on him than any one else; we took care, however, to keep his claws well filed, that we might not get an unintentional scratch. He was as playful as a kitten, and a few days after his cord had been taken away, he took it into his head to bound round the whole fort. The boy ran after him, which he mistaking for fun, only increased his speed, and caused him to dash through all the narrow spaces. Most of the inhabitants were frightened out of their senses, and it was highly amusing to see the sudden disappearance of all living things, even to the sentinels. When tired, he quietly walked in at my door, and his pursuers found him lying on the ground, beside me, composing himself to sleep, whence he was taken without the least resistance. * * Sai's chief amusement was standing on his hind legs, resting his fore paws on the window-sill, and fixing his head between them, in this posture to contemplate all that was going on in town below. The governor's children, however, often disputed this post with him, and dragged him down by the tail, which he bore with perfect good humor. * * An old woman, who always swept the great hall before dinner, was performing her daily office with a small hand-brush, and consequently going over the floor on her hands and knees. Sai, who had been sleeping under one of the sofas, suddenly rushed out, and leaping on the woman's back, stood there with his head on one side, his tail swinging backwards and forwards, the very personification of mischief. * * The governor and myself, hearing the noise, also came to the scene of action, when Sai descended from his station, and held his head to us to be patted, as if in approbation of his feat.

The time came for him to be embarked, and he was shut into a large, strong cage, with iron bars in front, and put into a canoe; while there, the motion made him restless, and he uttered a howl, which so frightened the canoe men, that they lost their balance, set up a howl in echo, and upset the canoe. We were watching his embarkation from one of the castle windows; and when we saw the cage floating on the waves, we gave our pet up as lost; and I am not sure that we did not make a trio in the cry; but fortunately a boat immediately put off from the ship, the men in which caught hold of the cage just as it was on the point of sinking. The panther was installed close by the foremast, and I did not fail to pay him a visit the moment I went on board. He was very dull, and, perhaps, a little sea-sick, but was half frantic with joy on seeing me.—[Ibid.]

On the Obstruction of Cast Iron Water Pipes, by the formation of Nodules of Oxide of Iron within them. By M. Payen.

[Translated for the Journal of the Franklin Institute, by Jos. Wharton, at the request of the Committee on Publications.]

A singular effect has been lately observed to take place by use in cast iron water pipes, in certain cities. The passage of the water becomes gradually obstructed, by the formation of nodules of impure oxide of iron, of a light brown or greenish color, which adhere to the internal surfaces of the pipes.

This subject being one of the greatest importance in connection with the health of cities, and the agriculture of various districts, required an elaborate investigation, which I undertook, and of the results of which the following is a succinct account.

All soluble substances that give an alkaline reaction to water, such as potassa, soda, ammonia, and lime, the carbonates of potassa, of soda, and of ammonia, the borate of soda, and the sub-acetate of lead, are capable of preventing the oxidation of iron.

The relative proportions of these substances, and of the water, required to produce the effect, varies with the alkaline agent employed, and is also affected by the presence of certain foreign salts; the alkaline agents being the same, the nature and quantity of these salts determine the proportions.

When the quantity of alkaline matter is insufficient, oxidation ensues; but it is remarkable that all the points of the surface are not, in this case, equally oxidized, so that the nodular form of the concretions must be assumed from the beginning. The preserving force is overcome only in places where the continuity of the surface has been interrupted, even although it be by an almost imperceptible division. Thus, for instance, the lines on fibrous iron, and the points where the parts of the iron are separated by foreign bodies, are oftentimes pointed out by traces of greenish oxide, which gradually fill up, while the rest of the surface preserves, for a long time, its metallic aspect; and hence the advantage of an iron as *mechanically* pure as possible. The points of contact between a connecting pipe, and the sides of a main, or between two pipes, are likewise sufficient to determine the effect.

The following are a few experiments upon these points.

A cylinder of polished iron, immersed in a saturated solution of pure potassa, diluted with 1000 times its volume of water, (the temperature being 59° Fahr.) was preserved untarnished for a long time; but as the carbonic acid of the air gradually weakened the intensity of the alkaline action, signs of oxidation began to exhibit themselves at various points, and became more and more apparent, while the greater part of the surface preserved its lustre after the lapse of a year.

Conical concretions of oxide were gradually formed on the surface of an iron cylinder, when the latter was immersed in water containing 0.02 parts of its volume of a saturated solution of carbonate of soda. The color of these concretions was a greenish brown, which acquired a yellowish cast at their summits, while the base in contact with the metal retained its original greenish brown color. The liquid was not protected from the air.

The same saturated solution being used, but diluted with fifty-nine parts of water, and kept for a year, in an open tube, in contact with polished cylinders of iron, greenish concretions were first

formed, which slowly passed round the cylinders, and gradually assumed a beautiful yellow tint, whilst the rest of the surface, even of that part which, by the evaporation of the liquid, was uncovered, preserved its metallic state. In the same circumstances, the iron has been completely preserved from oxidation in water containing 0.023 of a saturated solution of carbonate of soda.

In a saturated solution of chloride of sodium,* protected from the air, there appeared, on the surface, and, it is to be particularly observed, *on the points of contact* between several bars of iron, only some protuberances of greenish oxide, the remainder of the surface preserving its metallic lustre after the lapse of a year. In a similar experiment made in contact with the air, the oxidation continued, and assumed the color of rust, beginning with the parts nearest the surface of the liquid.

A solution saturated with marine salt, and carbonate of soda, preserved iron entirely from oxidation, for the same space of time, notwithstanding the presence of atmospheric air, and a crystallization of a part of each of the two salts.

The same solution, diluted with nine volumes of water, afforded concretions of oxide.

In endeavoring to obtain, in accordance with the above experiment, the exact proportions of water, of chloride of sodium, and of carbonate of soda, the most favorable to the formation of local concretions of oxide, I found that a saturated solution of the two last, (the solution being made at the temperature of 59° Fahr.) diluted with seventy-five times its volume of water of the Seine, (see note 3,) and filtered, produced, in less than a minute, an oxidation both on wrought and cast iron. The effect was first shown by the appearance of points of a pale green; in ten minutes' time, the lines were well defined.†

When, in compliance with a suggestion of M. Becquerel, the power of electric conductibility was increased, by bringing, by means of a wire, a fragment of well calcined charcoal into contact with a polished bar of wrought or cast iron—the other circumstances being the same as in the preceding experiment—the greenish protuberances were developed still more rapidly, and in much greater number.

In weak alkaline solutions of the same substances, freed from atmospheric air, oxidation does not ensue.

In those containing atmospheric air, oxidation is arrested when the access of the exterior air is prevented.

When the air of the atmosphere has free access, the concretions nearest the surface pass into a higher state of oxidation, while the greenish oxidation continues, at other parts of the surface, on the points at which it began.*

The figure of the concretions is sometimes irregularly rounded, sometimes conical, and, at times, variously ramified into winding bands.

Bars of wrought and cast iron, polished, which have been, for the last four days, immersed in water, that had previously stood in contact with a portion of white marble, in the form of a well washed powder, already exhibit, near the surface of the liquid, points of a greenish oxidation, and rust in a floculent state.

The following conclusions may be drawn from the preceding facts, and others not mentioned.

1. That all solutions, having a slight alkaline reaction, may, while the general surface is preserved, occasion the formation of local concretions of oxide, at certain points of the surface of iron immersed in them.†

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* (1) In making a saturated solution of chloride of sodium, in water of the Seine, the liquid suffered a contraction equal to 0.03 of its volume, and disengaged 0.015 of the same volume, of gases contained in the water. The temperature was 59 Fahr., and the pressure 30 inches.

† (2) The chloride of sodium, when present by itself, in small proportions, in water, determines, on the surface of polished iron, local oxidations, which remain greenish colored the longer, and preserve the remainder of the surface the better, accordingly as the iron is farther removed from the surface of the liquid in contact with the air; but these oxidations do not assume the nodular form.

* (3) In all the preceding experiments, made with a view to their practical application, the water used was taken from the river Seine, and filtered after its mixture with the alkaline solution, and the subsidence of the precipitate, (which fell in consequence.) The temperature during the experiments varied from 59 to 62.6, and from 68 to 69.8, Fahrenheit. Several of these experiments, repeated with the use of distilled water, gave the same results, when the proportions of the alkaline substance, of the atmospheric air, &c., were the same.

† (4) Wrought and cast iron, half immersed in a weak ammoniacal solution, were preserved, by the

. That the general character and rapidity of this process varies with the presence, and according to the proportions, of atmospheric air, and different salts, that may be brought into action, and is further determined by the presence of breaks in the continuity of the surface of the metal immersed, whether these interruptions exist in a single piece, or at the lines of separation between different pieces of iron, or even between the latter and other substances.

3. That acid solutions determine a uniform, and less bulky, oxidation; on copper, both acid and alkaline solutions determine a general oxidation.

Local concretions must then be expected to ensue in wrought or cast iron pipes, when exposed to a current of water slightly saline, and having a feeble alkaline reaction. In such case, it will be necessary either to abandon the use of this metal, or at least to contrive convenient places of access to the pipes, at short distances from each other. In this case, owing to the minute state of division of the particles, and the granular formation of the concretions, the obstruction may be removed by the application of a gentle friction, or by the assistance of a diluted acid, too weak to injure materially the metallic parts.

Note by the Translator.

The general properties developed in this paper, as belonging to all alkaline solutions, are considered by the author to present a new series of electro-chemical actions to the attention of the scientific chemist.

[From the Journal of the Franklin Institute.]

Remarks in relation to some new Concretions, produced artificially on Iron. By M. Payen.

In a recent paper, the results of which have been verified by M M. Becquerel and Dumas, I made known a method of forming the protoxide and peroxide of iron, in the shape of nodular concretions, on certain points of the surface of iron,* while the remainder of the surface preserves unchanged its metallic state.

An investigation, having its origin in the electro-chemical theory, and the properties of alkaline solutions, has led me to the discovery of another kind of local concretions, produced by a series of still more complicated reactions.

A polished cylinder of soft iron was kept immersed, for a year, in a close vessel, in a solution of sub-acetate of lead, and consequently exposed to the influence of an alkaline reaction; for a short period, no signs of oxidation were observable, but it afterwards became studded with a number of spongy, greyish excrescences, which presented themselves on a line parallel to the axis, (see preceding paper.) The remainder of the surface of the iron preserved, unaltered, its original appearance.

The concretions were made up of small particles, aggregated in the form of a metallic sponge, that presented the appearance and ductility of lead.

A slight friction was sufficient to unite the particles when separated, and to give the mass the brilliancy of that metal.

When flattened together under a slight pressure, and heated in a tube out of contact with the air, they melted, and hardened, on cooling, into a dross, that possessed all the properties of lead.

The liquid itself remained limpid and colorless throughout the year; afterwards, when exposed to the air, it quickly assumed a yellowish brown color, which gradually deepened; it still possessed a feebly alkaline character.

A portion of the liquid being treated with sulphuric acid, acetic acid was developed. Another portion, by the action of a soluble sulphate, gave a precipitate of sulphate of lead, and the supernatant solution had all the properties of the salts of iron.

The tube in which the solution, and the immersed iron, were enclosed, contained, then, evidently, the following substances, present, at the same time, together.

1, sub-acetate of lead; 2, metallic iron; 3, lead, in the form of a concretion; 4, acetate of iron, partly acetate of the peroxide.

It appears to me to follow, from the preceding facts, that, at the points where, by the presence of foreign bodies, and in-

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vapor of the ammonia mingling with the air above the liquid, during all the variations of temperature throughout the year. The solution contained 0.1 of ammonia. All the above mentioned concretions are composed of a mixture of hydrated protoxide and peroxide of iron; the proportion of the latter slowly increases.

* The preceding paper is the one referred to by the author.—[Translator.]

terruptions in the continuity of the surface, the elements of a pile are constituted, the iron is oxidized at the expense of the oxide of lead, the latter metal being revived, and aggregating in concretions, at the same points, while the oxide of iron, united to its equivalent of acetic acid, diffuses itself in the liquid.

By the continuance of the same series of reactions, the volume of the concretions is augmented, while, by the alkaline reaction of the undecomposed sub-acetate of lead, the rest of the surface of the iron is preserved from oxidation, and is thus enabled to maintain its metallic lustre.

[From the Scientific Tracts.]

A LETTER TO DR. FRANKLIN, BY A SEAMAN, MANY YEARS AGO.—I have often wished that somebody would carefully collate a sufficient number of meteorological journals, with intent to observe and class the several appearances in the atmosphere before great changes in the weather, particularly before great storms. I am persuaded, from my own observation, that, in general, sufficient indications of impending tempests precede them a considerable time, did we but carefully note them.

The phenomenon which I am going to mention, is one of those indications which not only portend an approaching tempest, but ascertain from what quarter it will come: a circumstance that may render it of essential service to seamen. I believe the observation is new, that the aurora borealis is constantly succeeded by hard southerly or south-west winds, attended with hazy weather, and small rain. I think I am warranted from experience to say, constantly; for in twenty-three instances that have occurred since I first made the observation, it has invariably obtained. However, I beg leave to request that you will recommend it to the notice of the Royal Society, as a matter which, when confirmed by further observations, and generally known, may be of more consequence than at first appears. To show that it may, give me leave to recite the circumstance which first occasioned my taking notice of it. Sailing down the English Channel in 1769, a few days before the autumnal equinox, we had a remarkably bright and vivid aurora the whole night. In shore, the wind fluctuating between N. N. W. and N. W., and farther out W. N. W.; desirous of benefitting by the land wind, and also of taking advantage of an earlier ebb tide, I dispensed with the good old marine adage, "Never to approach too near a weather-shore, lest it should prove a lee shore," and by short tacks clung close along the English coast. Next day the wind veered to the S. W., and soon after to S. S. W. and sometimes W. We were then in that dangerous bay between Portland and the Start Point, and carried a pressing sail, with hopes of reaching Torbay before dark; but night came on, with thick haze and small rain, insomuch that we could not have seen the land at the distance of a ship's length. The gale was now increased to a storm: in this dilemma nothing remained but to endeavor to keep off the shore till the wind should change. Luckily, our ship was a stout one, and well rigged.

Reflecting, some time after, on the circumstances of this storm, and the phenomena that preceded it, I determined to have particular attention to future auroræ, and the weather that should succeed them; and, as I observed above, in twenty-three instances have found them uniform, except in degree; the gale generally commencing between twenty-four and thirty hours after the first appearance of the auroræ. More time and observation will probably discover whether the strength of the succeeding gale is proportionate to the splendor and vivacity of the aurora, and the distance of time between them. I only suspect that the more brilliant and active the first is, the sooner will the latter occur, be more violent, but of shorter duration, than when the light is languid and dull. Perhaps, too, the color of the aurora may be some guide in forming a judgment of the coming gale. That which preceded the storm I have mentioned, was exceedingly splendid. The tempest succeeded it in less than twenty-four hours, was violent, but of short continuance. In June last, a little without soundings, we had for two nights following faint inactive auroræ; the consequent gale was not hard, but lasted nearly three days; the first day attended with haze and small rain, the second with haze only, and the last day clear.

The benefit which this observation on

the aurora borealis, when further confirmed, may be to seamen, is obvious, in navigating near coasts which extend east and west, particularly in the British Channel. They may, when warned by this phenomenon, get into port, and evade the impending storm; or, by stretching to the southward, facilitate their passage by that very storm which might otherwise have destroyed them; for no winds are so dangerous in the Channel as the southerly and south-west. In a word, since I have made this observation, I have got out of the Channel, when other men, as alert, and in faster sailing ships, but unapprized of this circumstance, have not only been driven back, but with difficulty have escaped shipwreck.

Perhaps the observation, that southerly gales constantly succeed these phenomena, may help to account for the nature of aurora borealis. My own thoughts on that subject I shall sometime beg leave to lay before you. J. S. WINN.

[From the same.]

CONTACT OF COMETS.—In the course of a lecture on comets, delivered at the Royal Institution, by Dr. Lardner, on Friday evening, the 1st of May, the lecturer took occasion to allude to a report which has been going the rounds of the newspapers, purporting to come from Sir John Herschel, to the effect that Halley's comet, which is expected to make its appearance in the course of the present year, had long since changed its course, and now revolved in another orbit. Dr. L. observed, that Sir J. Herschel had not any means of ascertaining such a change, other than those possessed by any other astronomer; and he was of opinion that the paragraph was either a fiction, or else greatly exaggerated, exemplifying the story of the three black crows. There are only two circumstances from the occurrence of which the orbit of a comet can be changed. In its course it may meet with a planet, the attraction of which may be sufficient to produce such an alteration, or it may cross the path of another comet, and either coalesce with it, or be acted on so as to produce that effect. Sir J. Herschel, however, has no means of ascertaining that either of these circumstances has occurred in the present instance, and Dr. L. sees no reason to doubt that the comet will make its appearance.

In the course of the lecture, Dr. Lardner mentioned a curious fact relating to the splendid comet which appeared in June 1770, and was observed by Messier, surnamed by Louis XIV. the *comet ferret*. It passed within the orbit of Jupiter, and was visible in an unusually large part of its course, which was very carefully observed and noted. Messier not being a mathematician, Lexon computed the observations, and laid down its path. He at first considered its course was a parabola, but not being able to compute it correctly according to that supposition, he examined further and ascertained that its orbit was an ellipse, and its course would be completed in about five years and a half. Considerable attention was excited on this occasion, and its re-appearance anxiously looked for; the time passed, however, and the comet did not make its appearance, nor could any account of any previous visit be discovered.

This fact proved a complete problem until Laplace grappled with it; and he ascertained by accurate investigation, that this comet of 1770, during its course, on the 18th of January, 1767, at noon, came in contact with the planet Jupiter, and remained entangled for about six months. Previous to this it described an orbit of fifty years, but the new orbit in which it revolved after its contact with Jupiter, was one of five years and a half. In this manner Laplace accounted for its non-appearance previous to 1770, inasmuch as previous to that date its path was so distant as to render it invisible. The explanation given for its non-recurrence was equally feasible. Jupiter runs its course in eleven years, and this comet in its new orbit completed its revolution in five and a half. At the end, therefore, of the first five years and a half, the planet Jupiter being then at a great distance, the comet should have been seen, but it so happened that at that time the earth was in such a position with regard to the sun, as to render it invisible. When the period approached for the completion of its second revolution, it was again met by the planet Jupiter, and again its orbit was changed. The ellipse into which it was thrown this time was one of 20 years, and its path was so distant as to render it again invisible.

[From the Journal of the Franklin Institute.]

Remarks on Competition Plans for Buildings.—Every person, whose attention has been in the least degree directed to architecture, must have observed that, in the present day, the practice of procuring plans for buildings, by public competition, is becoming more and more prevalent. It is, perhaps, only of late years that this custom has been generally acted upon; and it is more commonly employed in the case of public buildings than in those of a private nature. When a public building is about to be erected, the parties advertise a description of what is wanted, offering, generally, a premium for the best plan, or for that which shall be finally adopted. Sometimes the successful competitors have nothing for their reward but that of being employed to conduct the work, for which they are paid as in ordinary cases. The plans submitted are, or should be, distinguished by a private mark, referring to a sealed letter sent by the competitor, in which his real address is to be found; and it not unfrequently happens that there will be from forty to fifty of such plans sent in, varying, of course, in equally numerous degrees of merit. Not a few of these drawings are the result of great labor, seldom occupying the time of the competitor for less than three weeks, and, if the building be very extensive, and the design well matured, having employed his sole attention for months together. The unsuccessful competitor, consequently, sustains a very serious loss; as he is not like the landscape or figure painter, who can carry his drawings to the market; the plans of the architect can be of no use but for the purpose for which they were originally intended. In fact, there cannot be, in any other profession, a competition which requires such a sacrifice on the part of the competitor, as in architecture; and, were this sufficiently impressed on the public mind, there can be no doubt but the labors of the architect would, in all such cases, be more duly appreciated, and, at least, rewarded with an impartial distribution of justice.

It may here be remarked, that sufficient time is seldom allowed by the advertisers for preparing the plans; for it will be confessed by every architect, that the faults of his composition will be easier detected by himself, after it has been laid aside for a time; we should say, therefore, that six months, at least, should be given, or even a longer period, according as the subject may require.

Although the system of competition in architecture is accompanied with no small expense to the parties competing, yet it cannot be denied that, when rightly conducted, it is conducive to the greatest advantages to the public, and is the only true method of eliciting the brightest talents of the country, especially when the premium held out is of sufficient value to induce proficient architects to come forward with their works; and, surely, the erection of a building which is destined to continue for ages, standing forth to prosterity as an example of the architectural genius of our time, is not unworthy of the most sedulous attention. The practice has also a beneficial effect, in affording to a young architect facilities, which he could not otherwise possess, of pushing himself forward. Private competition plans are sometimes required, where the competitors are previously chosen out, and where all are paid a certain amount for their trouble, whether successful or not; this is certainly the most liberal method, and should be adopted where the funds are sufficient.

In most cases where a decision is made on competition plans, the judges consist of men who are but indifferently qualified for the task, and whose fancy is easily carried away by a gaudy picture, the intrinsic merits of which they are incapable of appreciating; or, perhaps, by a design which has nothing else to recommend it but that of being so common-place in its character, as to be more familiar to their ideas than one of higher pretensions. Indeed, it is not to be supposed that men, whose pursuits of life are so totally unconnected with the subject, as never even to have led them to the inspection of a simple plan of a house, should be able to form a correct judgment of a number of elaborate drawings. It often happens, indeed, that the judges are so bewildered with the brilliant display before them, that they readily give way to some almost equally ignorant but pretending builder, to whom they look up as to the architectural oracle of their body, and who, it may be supposed, will not let slip such an opportunity of serving his own ends. This may, perhaps, be thought rather an uncharitable conclusion; but, certainly, there is but too much reason to fear that sinister influences have, in many cases, had an undue weight, and it is the particular object of this article to point out these grievances.

On such occasions as that we are just referring to, the most obvious method of proceeding, and that which would be the most entirely free from all suspicion of partiality, would be to name two or more architects, of acknowledged celebrity in their profession, (and residing at a distance,) to whom the plans should be sent for final decision. Care should also be taken by all

judges, in forming their decision, to keep in mind the terms of the competition; for, although the value or cost of the building required by the advertisement be strictly attended to by some competitors, yet there are others who will disregard it, and will produce an elegant design, although its expense should be double the stipulated estimate, and who, by this trick, may blind the judgment of the umpires, and carry off the prize.

The undue means which are sometimes resorted to by competitors to forward their own cause, are disgraceful in the extreme: some have been known openly to carry about their designs, for the purpose of procuring votes, before the general election; some unfairly attach their names to their plans, (instead of using a private mark, as they ought to do,) in the hope that their friends may exert undue influence in their favor, or form a vain confidence in their own importance, which leads them to expect that the name alone will produce a favorable impression; and some have even been known surreptitiously to withdraw their designs from the exhibition, in order to add improvements which have been suggested by the designs of another: nay, such is the total want of principle, and disregard of justice to the competitors, shown in some cases, that an instance could be brought forward where one of the competitors was appointed the judge! This competitor judge most naturally gave his decision in favor of his own designs, and the unsuccessful competitors were dismissed with the most cogent and satisfactory argument, that "the judge was a man of such respectability, that he would not have chosen his own design, unless he had considered it the best!" Is it possible to conceive that language could be so sophisticated as to apologise for such conduct? Thus it is that nine out of ten competitions are decided, and thus are the architects treated who have spent a large portion of their valuable time for the benefit of the public. It must be acknowledged, however, that isolated cases occur, though few and far between, where no complaints of this nature can be made, and where fair play has been allowed to have had full scope. The Tron Church steeple, Edinburgh, erected, in 1828, by the architects Messrs. R. and R. Dickson, may be mentioned as an instance of fair competition; the choice of the plan reflects the highest credit upon the then magistrates of the city, who made their election from a great number of designs. Considering its cost, this steeple, for aptness, originality, and picturesque beauty, can scarcely be surpassed in any country. It would not be easy to cite many instances of the same kind in Scotland, but we may mention another, viz.: Burns' monument at Ayr, by Thomas Hamilton, Esq., of Edinburgh. This is an exquisite gem of Grecian architecture, of which school its tasteful architect is a distinguished disciple. Finally, it is evident that the grievance here complained of, and which calls so loudly for redress, is in no way amenable to the civil law, unless in such a case as we have before hinted at, viz.: where the judges do not abide by the advertised terms of the competition. Even in such cases, we are not sure how far they lay themselves open to have their proceedings legally called in question, so that an appeal can only be made to the moral rectitude of society; and we have no doubt that the evil only requires to be fairly exposed, to be, in time, totally eradicated.

Edinburgh, October, 1834.

Franklin Institute.—The seventh conversation meeting of the Institute, for the season, was held at their Hall April 23d, 1835.

Mr. Thomas Ewbank, of New-York, exhibited a series of experiments on the rarefaction produced in the air within a tube, by blowing through another tube inserted into the first; the tubes were variously connected, and proportioned in dimensions, and the degree of rarefacation produced in each was measured by the rise of a column of water into the tube.

Mr. Ewbank showed that this principle might be applied conveniently to syphons, the flow of water through them being commenced by blowing through a lateral tube. He also exhibited a syphon, the shorter leg of which terminated in a tube, widening as it receded from the bend, and which was filled by stopping the longer leg with the finger, and immersing the other leg of the syphon in a liquid; on the removal of the finger, the momentum of the liquid carried it up the shorter leg, passing the bend.

Messrs. Lehman & Duval, of Philadelphia, exhibited various specimens of lithography, drawn and printed at their establishment.

Professor W. R. Johnson showed an apparatus intended to illustrate the principle upon which rockets ascend, and to show that such ascent might take place in vacuo, and, therefore, could not be produced by the re-action of the gas, issuing from the rocket upon the air without. The apparatus consisted of two revolving arms, with opposite apertures, like those of Barker's mill; this was placed in an exhausted receiver, and set in motion by admitting air through the apertures into the receiver. The arms were furnished with broad wings,

presenting a large surface to resist the motion through air. The velocity was perceived to be greater as the vacuum was more perfect.

Source of Animal Heat.—From observations lately made by Mr. Hermann, it would appear that the modern doctrine of the formation of animal heat is founded upon just grounds. According to this theory, animal heat is nothing but a chemical product, resulting from a process analogous to combustion, and which takes place during the respiration. In this theory, animals who do not form any water by their respiration, ought to produce as much caloric as the carbon which they transform into carbonic acid would emit by being consumed. This proposition has been confirmed on three chaffinches on which Mr. Hermann lately experimented. In the space of forty-eight hours these birds reduced to a liquid, in the calorimetre of Lavoisier, 16,965 grains of ice, and 1652 grains of carbon were found in the nutriment which the birds had taken during that time. These numbers accorded very closely with those resulting from theory; for if we admit that one part of the carbon, while being converted into carbonic acid, melts 104 parts of ice, the 102 grains of carbon should melt 17,180 grains of ice.—[Scientific Tracts.]

METEOROLOGICAL TABLE,

For the months of June and July, 1835—kept at Avoylle Ferry, Red River, Lou., (Lat. 31° 10′ N., Long. 91° 59′ W. nearly,) by P. G. Voorhies.

JUNE.

Days.	Morn.	Noon.	Night.	Wind.	Weather.	Remarks.
1	71	84	71	calm	clear	light showers in the morning—wind N.W.
2	70	82	72	W	cloudy	light showers morning and ev'g—had roasting ears for dinner
3	70	83	79	calm	clear	cloudy m'g—clear at noon
4	72	86	82	..	..	
5	72	87	76	..	..	
6	70	88	82	SE	..	Red river on a stand
7	75	88	84	..	..	
8	72	77	84	S	..	
9	70	84	74	E. light	..	rain in the evening—Red river falling
10	73	81	73	calm	..	heavy rain in the even'g
11	72	78	86	SW	cloudy	clear at noon
12	71	86	74	calm	clear	
13	74	81	77	..	cloudy	rain in the evening
14	73	79	75	..	..	.. morning and noon
15	72	77	76	..	..	clear in the evening
16	71	84	78	..	..	rain in m'g—clear at noon
17	74	85	82	..	clear	
18	73	88	82	..	..	
19	73	88	86	..	..	
20	75	87	85	..	..	
21	74	86	78	..	..	
22	72	81	78	..	cloudy	clear at noon
23	73	87	77	..	clear	rain in the evening
24	72	85	79	..	cloudy	light showers at noon
25	75	82	82	..	..	rain and thunder at noon—clear evening
26	74	84	80	..	..	light showers at noon
27	77	85	76	..	..	.. .. .. —clear evening
28	79	86	83	..	clear	thunder at noon
29	72	88	84	SW	..	
30	79	88	82	calm	..	rain and thunder in ev'g

Red river rose this month, 1 foot 4 inches—and is below high water mark, 6 feet 6 inches.

JULY.

Days.	Morn.	Noon.	Night.	Wind.	Weather.	Remarks.
1	68	72	71	SW	cloudy	rain in the morning, & clear in the evening
2	62	78	70	calm	clear	
3	61	77	74	..	..	
4	70	80	76	..	cloudy	
5	71	77	73	..	..	drizzly rain all day
6	68	80	76	..	clear	Martin birds left here
7	67	82	75	SE	cloudy	thunder and rain in ev'g
8	70	84	77	calm	clear	
9	74	84	73	..	cloudy	very heavy rain in afternoon, and thunder
10	73	80	73	SW	..	very heavy rain in ev'ng
11	73	80	76	calm	..	Red river on a stand
12	73	84	75	SE	clear	thunder st'm at noon, & little rain—wind S.E.
13	73	84	81	calm	..	foggy morn'g—thunder at noon and evening
14	74	88	76	..	cloudy	thunder in the morning, rain noon and ev'ng
15	71	79	76	..	..	clear in the evening—Red river rising
16	71	83	79	..	clear	
17	72	85	82	..	cloudy	
18	73	82	72	..	..	rain in ev'ng and all night
19	70	72	70	..	..	.. all day
20	71	75	74	N. E. light	..	rain all day, and showers at night
21	72	73	72	E	..	.. ..
22	72	78	73	calm	..	rain severe in forenoon, evening clear
23	70	81	79	..	clear	thunder in forenoon, & cloudy in evening
24	74	85	82	..	..	foggy morning—clear balance of the day
25	74	86	83	..	..	.. ..
26	80	89	82	..	..	thunder, wind S.W. in ev'g
27	74	87	84	..	..	rain in ev'ng, & thunder
28	78	86	84	..	..	
29	76	89	86	..	..	
30	76	89	78	.	..	rain and thunder in ev'ng
31	75	84	82	..	cloudy	foggy morning—showers at noon

Red river rose this month, 6 inches—below high water mark, 6 feet.

MECHANICS' MAGAZINE,

AND

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FIRST ANNUAL FAIR OF THE MECHANICS' INSTITUTE.

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REPORT.

To the Mechanics' Institute of the City of New-York, the General Committee of Arrangements respectfully report:

That the first Annual Fair of the Institute was held at Castle Garden, and that the Exhibition was opened to the public on the 29th of Sept. and continued until the 3d of the present month inclusive, during which time they estimate that 40,000 of their fellow citizens visited the Garden.

Although free admission was given to the members of the Institute and depositors of goods, and cards of invitation issued to the judges, the municipal authorities of this city and the neighboring places, the gentlemen connected with the press, and numerous distinguished individuals, the total receipts amounted to $2,188, which it is believed will be found very nearly or quite sufficient to defray the expenses on that occasion, a detailed account of which will be presented as soon as the Sub-Committee on Finance shall have closed their labors. This result is more flattering than could have been anticipated, when it is recollected that a beautiful plate for printing diplomas and a pair of dies for striking medals have been procured, and are now the property of the Institute; an expense which will necessarily not again recur. Among other advantages to the Institute, the accession of rising 300 members may be enumerated.

The Committee must remark, that the quantity and variety of the articles exhibited, exceeded their most sanguine expectations, and that the quality reflected

the highest credit upon the skill and ingenuity of the contributors, and gave irresistible and gratifying evidence of the rapidity with which our country is advancing in the arts and in manufactures.

The Committee herewith submit notices of the various articles exhibited, and a list of the premiums that have been awarded. They have been prepared by their Sub-Committee on Premiums, and the attention of the Institute is invited to them.

Although the publication of these papers has been delayed for a longer period than was desirable, and many articles of merit have remained unnoticed in consequence of the want of information from contributors themselves, yet the Committee trust that the inexperience attendant upon, to them, a novel undertaking, will be considered a sufficient apology; and they feel assured that the valuable knowledge acquired in this first attempt will enable future Fairs to be conducted with greater pecuniary benefit to the Institute, and with increased interest to the public.

In presenting to you the results of our duties, and to the public a detailed exposition of the late Fair, it may not be irrelevant to the occasion to recall the cheering reflections arising from our present circumstances and future prospects.

It is impossible that we should not feel animated by the fact that our present number of active members *is more than one thousand*, and that the united energies of so large a portion of moral and intelligent citizens are, in their associate capacity, directed solely to the promotion of useful knowledge. Deeming knowledge both power and happiness, we should not be insensible to the influence which our efforts, well directed, may have upon our fellow citizens; nor can we think they will be unmindful of our objects and exertions. The diffusion of knowledge lays the foundation for every virtuous sentiment, and presents us with all the elements by which we are to be great or happy. Our means, derived from the public exhibition of American industry and individual contributions, concentrate in this great purpose, and we feel justified in anticipating a satisfactory result to ourselves, and an honor able appreciation by the public.

Lectures upon the Sciences and the Arts, a *Reading Room* and *Library*, now mark the efforts of our Association and the discriminating patronage of our liberal minded citizens. Further and still more efficient means are in progress to diffuse useful information, and thereby to advance the interests of a most important part of the community. These interests are, however, unlimited, and every honorable man, approving the objects we propose, is invited to co-operate in the measures and share in the effects of this Association. On reviewing our condition, our objects, and our resources, we are induced to proceed with additional zeal, we are stimulated to increased exertions, and encouraged in every laudable hope.

SAMUEL CURTER, Chairman.
L. D. GALE, Secretary.

NOTICE OF THE VARIOUS ARTICLES EXHIBITED, COMPRISING THE PREMIUMS AWARDED.

MACHINERY, MODELS, PHILOSOPHICAL APPARATUS AND INSTRUMENTS.

No. 8. *Double Power Under Shot Water Wheel.* Invented by W. F. Brown. This Wheel is simple in construction, and works with very little friction. From the form and relative position of the flights, and an inclined shute under the wheel, the water is used in the most effectual manner. The wheel can be driven with very little head, and works well when completely submerged. By the addition of gates, it will answer a good purpose for tide mills. The Committee have awarded to the inventor the Silver Medal of the Institute.

No. 2. *Bromly's Portable Shower Bath.* Considered very useful and ingenious. The Diploma of the Institute.

No. 124. *Assay Balance.* Jones & McDonald, 83 Fulton street. Workmanship beautiful, and sensible to the 500th part of a grain, when loaded with ten penny weight. The Committee award to the manufacturers the Silver Medal of the Institute.

No. 258. *Machine for Making Sea Biscuit.* Deposited by J. & C. Bruce,

121 Bowery. A very excellent invention, for which the Silver Medal of the Institute has been awarded.

No. 212. *Shingle Machine.* Invented by D. Flagg, and deposited by S. S. Webster. The Machine consists of a frame to support the machinery, a gate working vertically, with a frow or knife to cut the shingles from the bolt; a vibrating beam attached to this and to a crank-shaft to work the knife up and down; two knives to shave the shingles, with screws and wedges to graduate their distances, and to secure them; a driver, working horizontally, to drive the shingle through between the knives attached to the wrist of the crank-shaft by a pitman. In operating, the shingle bolt is placed on the rest against the guide plates, and as the crank-shaft revolves the end of the vibrating beam is brought down, whilst its other end ascends with the gate and knife which cuts off the shingle, and the next half revolution of the crank forces forward the driver with the shingle, carrying it through the casing between the scoring saws and knives, where it is shaped and shaved.

With two or three horse power the Machine turns out from 120 to 150 shingles per minute, and probably without more waste of timber than by the common method. The Committee award the inventor the Silver Medal of the Institute.

No. 6. *A Continual Draft Buoyant Paddle Wheel.* By N. Dodge.

No. 26. *Centrifugal Pump.* By Isaac Sloan.

No. 1. *Patent Platform Scales.* By Fairbank. This appears to be a good article.

No. 29. *Model of a Weighing Machine.* By H. Bartley.

No. 31. 2 *Steamboat Models.* By John Clark.

No. 149. 1 *Platform Scale.* By John J. Rohr, 242 Canal street. The Diploma of the Institute.

No. 95. *Portable Grist Mill.* Invented by D. Fitzgerald. The Judges decided this Mill to be by far the best in its construction, and most convenient for use, they have ever become acquainted with, and the Committee have awarded the Silver Medal of the Institute.

No. 253. *Iron Grist Mill.* By Payne & Reynolds. In this Mill metal has been substituted in the parts where burr stone is commonly used. From its convenient size, and the rapidity with which it grinds corn, it promises to be very useful.

No. 201. *Model of a Grist Mill.* By I. Sloan.

No. 262. *Iron Threshing Machine.* By Wm. G. Borland, Herkimer, N. Y. Yale & Curtis Patentees.

No. 217. *Threshing Machine.* By S. F. Warren.

No. 286. *Threshing Machine.* By James Maxwell.

No. 243. *Rotary Air Pump, new plan; Electro-Magnetic Apparatus.* By Hiram French, of Lansingburgh. Both of these are very ingenious, and worthy of the Diploma of the Institute.

No. 245. *Double Thread Screw Press.* A very good contrivance.

No. 197. 1 *Copying Press,* 1 *Notarial Press.* Both of good workmanship. For exhibition, by Robert Hoe & Co. the makers.

No. 221. *Machine for Pressing Straw Hats.* By James Maxwell, 259 Bowery. Was considered by the Judges a very ingenious and valuable contrivance. The Committee have awarded to Mr. Maxwell the Silver Medal of the Institute.

No. 277. 1 *Cider Mill.* Justin Ware. Simple and good. The Diploma of the Institute has been awarded.

279. *Safety Ladder.* Invented by John Schriber. Simple in its construction, expeditious in its operation, and with the assistance of guys on each side to prevent the oscillations attendant upon great elevations, may be made very useful. The Committee have awarded the Diploma of the Institute to the inventor.

No. 42. 1 *Iron Safe,* made by Birkbeck & Co. Brooklyn, L. I. The Silver Medal of the Institute.

No. 76. 1 *Iron Safe,* by Cruttenden & Riley, Brookyn, L. I. The Diploma of the Institute.

No. 57. *Iron Safes,* by J. Delano. These were considered very good.

No. 37. *Moveable Platform Scale.* Cole & Smith. The principle of this Scale was pronounced very correct, and the workmanship excellent. The Committee, at the recommendation of the Judges, have awarded to the makers the Silver Medal of the Institute.

No. 190. *Model of Steam Safety Boiler.* Invented by G. R. Clarke. This consists

of a double boiler, one inclosed within another.

No. 33. *Model of an Apparatus for preventing explosions in Steam Boilers.* Invented by S. Kennedy, 22 Hudson street.

No. 236. *Machines for Morticing*, by George Page. One for cutting common mortices, and one for morticing Wheel Hubs. Both are very good and valuable machines. The Silver Medal of the Institute was awarded to the inventor.

No. 189. *Hydraulic Pump*, by Ridgeway & Co. A good article.

No. 120. 1 *Pump, Suction and Force*, by John Conroy.

No. 215. *Machine for Cutting Straw*, by H. Haxley & Co.

No. 176. *Model of a Rail Road Axle.* Deposited by D. K. Minor. Very ingenious, and promises to be useful.

No. 149. *Jack Screw*, by John J. Rohr, 242 Canal street. Very good.

No. 223. *Jack Screws*, by W. Ballard. Good articles.

No. 32. *Portable Forge and Bellows.* Fairley, Concklin & Co. Very excellent, and so constructed as to be removed with great facility. The Committee have awarded a Silver Medal.

No. 68. *Model of a Patent Bellows.* By C. D. Holmes. This is a neat wood model of a Square Bellows, blowing a stream of air, at both the up and down strokes, into a rising head. The intention of the inventor is to produce a steady blast—a desideratum in the arts. The workmanship of the model is quite creditable to the inventor; but the object to be attained, namely, a steady blast, will, we fear, be a failure. In practice it will be found that the blast will not be so strong at the end of the stroke, on change of motion, as it will when the piston is in the centre, or half way of the box. The Bellows now in use, to wit, leather Bellows, with rising head-tub or cylinder, will each of them produce quite as steady a blast as the one referred to. Probably the best way of producing a perfectly steady blast, is either by using a fan Bellows, or two or more cylinder Bellows, acting at half centres, blowing into a reservoir or rising head.

No. 41. *Model of a Patent Lithographic Printing Press.* By P. Langlume. For exhibition.

No. 38. 1 *Platinum Lamp, and Model of a Door Spring.* By F. Schott. The workmanship of the Lamp was good, and the price, $2, although above that required in the list of premiums offered, is less than the same article, of equal quality, has been previously sold at. The Committee have awarded to Mr. Schott a Diploma for the Door Spring, which is ingenious and well calculated for the purpose for which it is intended.

No. 35. 4 *Ploughs and Improved Windlass.* By Wiley, Concklin & Co. Peekskill. For the Windlass, the Silver Medal of the Institute has been awarded. It is neat and compact, and so constructed that the lever need not be removed, and therefore much time is saved in its operation.

No. 252. *Model Churn, Angevine's Patent.* Deposited by F. S. Lane. Considered good.

No. 134. *Washing Machine.* By Asa W. Soule. Thought to be a good article.

No. 265. *Model of a Machine for Polishing Plate Glass.* The property of the Institute.

No. 220. *Model of a Fire Engine.* L. Campbell.

No. 209. *Electrical Cannon, and Cylinder for Electrical Machine, also Model of a Steam Engine.* Jonas Humbert, jr. Deposited for exhibition.

No. 104. *Balance Level.* Invented by F. Bartholomew. Intended as a substitute for the common Spirit Level. Workmanship very good.

No. 91. *Dipping Needle, Transparent Compass, Circular Protractor.* By Brown & Hunt. The Dipping Needle has the pivots turned very fine, and acting on agates. The horizontal circle on which the instrument turns is divided into single degrees, and has opposite verniers to read to five minutes. Spirit Levels, with adjusting screws, are also attached. Both the action and workmanship of the instrument are very excellent. The Circular Protractor has opposite verniers to read to single minutes, with an additional arm to carry the Rack Work motion. This instrument, as well as the Transparent Mariner's Compass, is a beautiful specimen. The Committee have awarded to the makers a general premium of the Silver Medal, and for each of the articles noticed, the Diploma of the Institute.

No. 133. *A Barometer, Thermometer, Hydrometer, in one Case.* 10 *Thermometers,* 1 *Surveyor's Compass.* By John Roach, 3 Wall street. The Committee have a

warded Mr. Roach a Diploma for the Compass, which is a well made instrument.

No. 289. *Printing Press of the New-York Transcript.* This Press is the Double Napier, improved by Mr. S. Newton, one of the firm of Robt. Hoe & Co. and was built for the Editors of the Transcript, by those enterprising gentlemen. The Press will run from 23 to 2500 impressions the hour, and was put in operation and the paper worked off every evening during the exhibition. The beauty of its operation attracted the attention of thousands of the visitors at the Fair. The Committee take this opportunity of making their acknowledgments to the Editors, Messrs. Hayward, Stanley & Co. for the kindness evinced by them in removing their press, at considerable expense, to the Garden, and they have no doubt that its exhibition contributed much to the gratification of visitors.

No. 71. *Armillary Sphere, or Problem Globe.* G. Vale, 84 Roosevelt street. Considered by the Committee of very great practical importance. The Diploma of the Institute.

No. 102. *An Extension Ladder, or Fire Escape.* John B. Gasner, 132 Chatham street, New-York City. Not having seen its practical operation, in cases of fire, the Committee are not prepared to speak of its utility; but if it can be made effective its advantages are incalculable. The inventor is entitled to great praise for so laudable an effort.

No. 103. *Model of a Brig.* George Slaughter, 7 Division street, New-York City. For exhibition.

No. 140. 2 *Artificial Legs.* James Kent, Brooklyn, N. Y. The Committee cannot, within the limits allowed them by this report, do justice to the skill and ingenuity of Mr. Kent in the manufacture of these articles. The application of artificial feet to the stumps, below the knee, having been tried and failing in Europe, the success of Mr. Kent will be duly appreciated, we believe, by a discriminating public. Lieut. Young having lost both feet, these artificial feet have been applied with complete success, so that the gentleman walks easily with the assistance of a cane only; he is a relative of Mr. Stoneall, Shakspeare Hotel. The Committee award the Silver Medal of the Institute for the Lady's Foot.

No. 207. 1 *Gig Patent Screw Boat—of Spanish Cedar.* Josiah Farr. This was uniformly admired for the beauty of its model, and its superior finish. The Committee are happy in awarding for so elegant an article, and one so deserving of competition in this City, the Silver Medal of the Institute.

No. 142. *Machine for Splicing Leather for Machine Cards.* Isaac Pierce. For exhibition.

No. 251. 2 *Magnets.* Jonas Humbert, jr. These were very powerful, and well made. For exhibition.

CHEMICALS.

No. 23. *Specimens of Polishing Powder. Do. Paste and Water Proof Paste.* To be reported upon and information communicated on trial.

No. 67. 4 *Boxes Austen's Patent Indian Rubber Oil Blacking.* Russel Austen, 113 Pearl street. Said to be water proof, and an excellent article for the preservation of leather. The judges, knowing its composition, can say with confidence that its materials will not injure leather, and from the specimens they have seen tried, they feel safe in inviting the public to make trial of the article.

No. 84. 8 *Bottles of Lemon Syrup.* Mr. Groening. The Syrup, the Committee think superior to any exhibited, and, indeed, of a most excellent quality. The Diploma of the Institute.

No. 94. *Samples of Plaster.* Duncan & Arthur, corner of Jane and West streets. Considered very good, but the Committee could not decide upon its merits in a powdered state, without a trial.

No. 96. *Chrystalized Prussiate of Potash.* Richard Brakell. Considered a most splendid specimen of chrystalization, and indicating great purity.

No. 110. 1 *Case of Perfumery, and 2 Glass Jars of Fancy Soap.* Johnson & Co. 39 Cedar street. The quality of these articles, generally, was the very best, and they were got up in elegant style. The Diploma of the Institute.

No. 118. 5 *Samples of Soap Stone Paint.* F. Bunker, 100 Barclay street, N. Y. This new article the Committee think bids fair to be very valuable in the arts; they therefore cheerfully recommend it to the public for a more particular trial of its merits.

No. 44. 1 *Dozen Lemon Syrup* M.

Haulenbeck, 144 Nassau street. Considered of excellent quality.

No. 196. *Lucifer Matches.* Hopper, 364 Broadway. For exhibition.

No. 158. 1 *Bottle of Writing Ink.* Noble Heath, No. 8 Hester street. The Committee think this the best ink they have ever seen, and they recommend it to public notice. A remarkable property of this ink is that it presents, when used on cards, &c. all the prismatic rays; it is really quite unique, and of surpassing beauty. The Diploma of the Institute.

No. 202. 1 *Box Allum,* 1 *do. Saltpetre,* 1 *do. Copperas,* 1 *do. Oil Vitriol.* Messrs. E. Peck & Son. The Copperas the Committee consider of a superior quality, and not surpassed by any ever manufactured. The Nitre was thought to be of the best quality also, but the Committee could not well determine its purity. The Oil of Vitriol was excellent. The Diploma of the Institute.

No. 124. *Chemical Preparations.* Dr. Lewis Feuchtwanger, Broadway, New-York City. The great variety of Chemical and Medicinal preparations here presented for exhibition, attracted the particular attention of the Committee, and they would say, in general terms, that the preparations were of great purity and usefulness, and worthy of special notice. The indefatigable industry of Mr. F. in manufacturing Chemicals, hitherto imported, many of which are superior to the foreign article, will, we trust, be duly appreciated by the public.

No. 39. 1 *Box of White Lead.* E Clark, Saugerties, N. Y. This specimen was considered equal, if not superior, to any in the country. The great purity of an article so worthy of competition, induces the Committee to award the Silver Medal of the Institute.

No. 271. 1 *Can of Copal Varnish.* Wm. Tildon. To be tested and reported upon.

No. 182. 1 *Can of Coach Varnish.* P. B. Smith. To be tested and reported upon hereafter.

No. 206. 2 *Bottles of Ink, and* 1 *Frame.* F. B. Callender.

BOOTS, SHOES, LASTS, AND LEATHER.

No. 36. *Ladies' Boots and Shoes.* F. S. & M. Morris, 388 Grand street, N. Y.

No. 63. 1 *Pair Dancing Pumps.* J. Field, Newark, N. J. Considered of excellent quality.

No. 69½. *Gentlemen's Gaiter Boots.* Lewis J. Durand, 159 Centre street. Best exhibited. The Diploma of the Institute.

No. 70. *Ladies' Slips and Wadded Boots.* John Broqua, 331 Broadway, New-York City. The Committee consider the Wadded Boots the best article exhibited. The Diploma of the Institute.

No. 83. *Children's Pumps, Sandal Slips, and Misses' Gaiter Boots.* Thomas Weeks, 157 Delancy street. For the best pair of Misses' Gaiter Boots and Sandal Slips, the Committee awarded the Diploma of the Institute.

No. 106. 1 *Pair Light Boots,* 1 *Pair Light Pump Boots,* 1 *Pair Cork Sole Pump Boots,* 1 *Pair Double Cork Sole Pump Boots,* 1 *Pair Dancing Pumps,* 1 *Pair Opera Pumps.* Kimble & Rogers, 104 Broadway, New-York City. The light boots and dancing pumps the Committee consider the best exhibited; they therefore award the Diploma of the Institution.

No. 135. 14 *Pair Moccasins.* Mrs. Nichols, 106 Chatham street. These were considered very good by the Committee, and worthy the Diploma of the Institute.

No. 138. 2 *Boxes of Lasts.* G. Coit & Sons, 305 Pearl street. The Gentlemen's Boot Lasts were the best offered, and thought worthy the Diploma of the Institute.

No. 145. *Ladies' Gaiter Boots and Slippers.* Made by W. J. Watson, 67 Fulton street, Brooklyn, N. Y. The best exhibited. The Silver Medal and Diploma of the Institute.

No. 160. 1 *Pair Double Sole Water Proof Boots.* Robert Walker, 44 Greenwich street. These were the second best exhibited, and of an excellent quality.

No. 191. 4 *Pairs Water Proof Boots.* Henry Brisch. These were considered by the Committee most excellent water proof articles. The Diploma of the Institute.

No. 51. *Ladies' Gaiter Boot Lasts.* Deposited by C. R. Williams, 62 Frankfort street. Considered the best offered. The Diploma of the Institute.

No. 194. 1 *Side of Sole Leather.* Wm. Brown, Brooklyn. This was of an excellent quality, and an article the Committee were pleased to see offered for competition. The Diploma of the Institute.

No. 107. 1 *Double Sole Boot*, 2 *Light do. and* 1 *Shoe*. C. B. & J. C. Green, 416 Broadway. Very good workmanship.

No. 204. 1 *Case*, 2 *Pair of Boots*. Robert Webber.

No. 210. 1 *Case Ladies' Shoes*. Benjamin Shaw.

No. 62. 1 *Pair of Dancing Pumps*. E. Severance, Newark, N. J.

No. 211. 3 *Lasts*. Wm. Shaw.

HATS, CAPS, AND FURS.

No 69. 1 *Case of Water Proof Hats*. Edward Townley, 148 Canal street.

No. 111. 3 *Silk Hats*. G. B. Alvord, 12 Bowery. These specimens were of a superior quality, and received the special notice of the Committee. For the best $3.50 Hat they award the Silver Medal of the Institute.

No. 114. 1 *Silk Hat*. Isaac M. Henderson, 133 Lewis street.

No. 92. 1 *Case of Otter Ladies' Caps*, 1 *do. Gentlemen's, and* 1 *do. Misses*. Charles C. Plaisted. The Committee consider these articles worthy of particular notice, and recommend Mr. Plaisted's work to the patronage of the public.

No. 163. 1 *Satin Beaver Lady's Hat*, 3 *Drab do. do*. S. Tuttle, 208 Chatham street. The Committee thought these, from the elegance of their finish, deserving the Diploma of the Institute.

No. 233. 3 *Straw Hats*. Mrs. Harrison, 43½ Division street. The ladies merit particular attention in the specimens of mechanical skill which they present for exhibition to the public, and the Committee are happy to find that attention so well deserved, as in Mrs. Harrison's Hats. The extreme fineness of the braid, the charming neatness with which they were sewed, and this perfection of the model, though unpressed, entitles this lady, in their opinion, to the Silver Medal of the Institute.

No. 238. 1 *Russia Silver Fox Boa*, 1 *Siberian Blue Ice-Fox do.*, 1 *do. Squirrel Cape*, 1 *do. Blue Fox do*. Christian G. Gunther. Considered very beautiful, and finely made. The Diploma of the Institute.

No. 248. 2 *Fur Hats*. A. & A. Barker. The Committee have thought these highly creditable specimens of workmanship, and therefore award the Diploma of the Institute.

No. 261. 2 *Ladies' Hats*. B. J. & J. W. Hunt. These were beautiful specimens of Ladies' Beaver Hats, and worthy the Diploma of the Institute.

No. 143. 4 *Otter Caps*. James Latourette, Pearl street. These were specimens of great superiority, and were not excelled by any exhibited, if they can be equalled in the country. The Committee cheerfully award the Silver Medal of the Institute.

GOLD AND SILVER ARTICLES.

No. 43. *A Case of Watch Dials*. William J. Mullen, New-York City. The Committee consider these specimens of American workmanship worthy of special notice, both for originality of design and elegance of workmanship. They have never been equalled by any articles of the kind, foreign or domestic; and when it is considered that heretofore a large sum of money has been sent abroad annually for these articles, the Committee feel at liberty to express unqualified praise in favor of the articles here exhibited; they therefore award to Mr. Mullen the Silver Medal of the Institute.

No. 52. 19 *Articles manufactured of Argentine, or German Silver*. H. Powell, Belleville, New-Jersey. These articles were of superior workmanship. The Silver Medal of the Institute.

No. 127. 1 *Case Pencil Cases, (No. 42, Ever Point.)* Woodward & Hale. Some of these evinced a most elegant style of workmanship, whilst the patterns were of the most chaste and approved kinds.

No. 184. 1 *Case of Spectacles*. J. L. Moore, 142 Chatham street. Considered neat and elegant patterns, and very finely wrought. The Diploma of the Institute.

No. 213. *Patent Lever Temple Spectacles*. P. Williamson, 270 Division street. These are an improvement of the ordinary Spectacle Frame, by means of the intersecting levers of which the temple part is composed. The levers being about one inch in length, are made circular, so that when riveted to each other, they are adapted to the conformation of the head. The whole arrangement of levers gives to these spectacle bows great elasticity and uniformity of action, and is, withal, very neat and novel. The Diploma of the Institute.

No. 228. *Gold and Silver Thimbles*,

and Spectacles. Platt & Brothers. The patterns of the Thimbles were much admired, and the Spectacle Bows were highly distinguished for their neatness, convenience, and elegance of finish. The Committee awarded the Diploma of the Institute.

No. 242. 2 *Bars of German Silver, 2 Rolls do. do.* Dr. Spieker, 191 William street, N. York. Considered by the Committee a valuable article, and capable of being appropriated to a great variety of useful domestic purposes: these specimens were of the finest quality. The Diploma of the Institute.

No. 205. 24 *Watch Dials.* Berger Webster & Co. These were a beautiful article, and thought by the Committee worthy of the Diploma of the Institute.

INDIAN RUBBER ARTICLES.

No. 123. 2 *Pair Indian Rubber Boots,* 1 *do. Shoes,* 1 *Knee Cap,* and 1 *Shoulder Cap.* Stephen C. Smith, 66 Chatham street. Many of these articles were considered by the Committee of superior quality, and particularly *the Ladies' Shoes,* from the admirable manner in which the cloth linings were incorporated with the rubber, so as to prevent them from becoming troublesome to the wearer, as they often do by being detached from the shoe. This is an invention of Mr. Smith's, and one which he applies with equal success to boots and clothing. The Diploma of the Institute.

No. 59. 17 *Pairs of Indian Rubber Shoes,* also 1 *piece Virgin Rubber,* and 1 *Sheet.* Corning & Son, 144 Water street. Considered of an excellent quality.

No. 179. *Machinery Banding, Stage Thorough Brace, and Gas Bag of Indian Rubber.* H. Raymond & Co. The superior excellence, and practical advantage, of the first named articles, entitle the gentlemen, as the Committee think, to the Silver Medal of the Institute.

No. 216. *Specimens of Indian Rubber.* Charles Goodyear, 13 Gold street. The Committee are of the opinion that of all the useful modifications and applications of this article, none exceeds, in novelty or utility, that discovered by Mr. Goodyear. The original coloring matter, by a process peculiarly his own, is removed from the material, and any other given to it, whilst, at the same time, it is deprived of all of its unctuous and aqueous qualities, and yet retains its elasticity, durability, and imperviousness. The Committee can have no doubt of the utility and success of this discovery, and therefore recommend it to the immediate attention of the public. The Silver Medal of the Institute.

No. 232. 1 *Roll Indian Rubber,* 1 *Coat and Pantaloons of do.* Samuel Chase.

No. 272. *Case of Indian Rubber Balls.* H. Percival & Co. Considered very good, and handsomely made.

CABINET FURNITURE.

No. 9. *Camp-Bed and Table,* (inclosed in the lid of a trunk.) Wm. W. Woolley, Broadway, New-York City. Considered remarkably convenient and ingenious. It will, no doubt, be in great demand, particularly with travellers. The Silver Medal of the Institute.

No. 40. 1 *Lady's Work Box.* John F. Hanson, 57 Poplar street, Brooklyn, N. Y. First rate workmanship. The Diploma of the Institute.

No. 108. 1 *White Polished Door.* Solomon Pancoast, 54 Spring street, New-York City. This was an elegant article, and its beautiful finish was particularly admired. The Diploma of the Institute.

No. 125. 1 *Lady's Work Box.* Edward Senior, 138 Bleecker street. Considered a good specimen of workmanship.

No. 81. *Lady's Work Box.* A. Patterson.

No. 171. 1 *Centre Table, Mosaic top.* Wm. Fulcher, 88 Elm street. An elegant article, and worthy the Diploma of the Institute.

No. 187. 1 *Sofa Bedstead.* Francis Breckles. Considered by the Committee the best specimen offered, and really of superior excellence. They award to the maker the Silver Medal of the Institute.

No. 193. 1 *Breccia Top Centre Table —Column of Marble.* Wm. Vine. The Diploma of the Institute.

No. 287. 1 *Sofa and* 1 *Centre Table.* S. Carter, 51 Beekman street. For exhibition.

No. 144. 1 *Portable Desk.* Lawrence Ryer. For exhibition.

No. 154. 1 *Sofa Bedstead.* W. Woolley, Broadway, New-York City. In Mr. Woolley's good style of workmanship.

No. 237. 1 *Divan Bedstead and Royal Foot Rest.* W. Woolley.

CUTLERY, EDGE TOOLS, AND HARDWARE.

No. 7. 2 *Pounds Bright Wire—six miles long.* 1 *do. fine do.* 1 *Bundle Square Wire,* and 1 *do. Round do.* No. 12, *Copper.* From E. Peck & Son, New-York City. Considered wrought in a superior manner. The Silver Medal of the Institute for the 2 lbs. bright wire.

No. 82. 62 *Gross Wood Screws.* Goodell & Co. Newburg, N. Y. The Diploma of the Institute.

No. 82½. *Four Plumb Spirit Levels.* J. & H. M. Pool, Easton, Mass. N. B. The Messrs. Pools are the inventors of this valuable instrument, and secured the patent in 1833. Too much credit cannot be awarded to these enterprising gentlemen, for their useful invention. The Silver Medal of the Institute.

No. 82½. 5½ *dozen Shovels and Spades.* Deposited by Mitchell Ames & Co. No. 2 Liberty street. Considered very good.

No. 98. 14 *Pairs Shears.* Rochus Heinisch. The specimens exhibited were of superior workmanship and finish, and deserving public notice. The Silver Medal of the Institute.

No. 112. 1 *Case of Stocks and Dies.* Daniel B. King, Waterford, N. Y. The Committee are of the opinion that these are equal, if not superior, to any of the kind in the country. They award the Silver Medal of the Institute.

No. 80. *Invoice of Files.* George Rothery, Bloomfield, N. J. Many of these were considered equal to any imported, doing much credit to the manufacturer, by so successful a competition with the foreign article. The Silver Medal of the Institute.

No. 132. 1 *Case Steel Pens.* C. Atwood, 72 Maiden Lane. Considered very good in style and execution. The Diploma of the Institute.

No. 141. 6 *Dirk Knives.* Robert Ward. The Committee think these specimens of workmanship have great elegance and perfection. They award the Diploma of the Institute.

No. 167. 4 *Bundles of Iron Wire.* E. Peck & Son. These specimens were thought by the Committee to be of superior quality and workmanship.

No. 268. 2 *Augers.* Upson & Campfield, Humphreysville, Ct. These were superior articles, doing much credit to the manufacturers.

No. 269. 9 *Auger Bits.* Clark & Hartshorn, Humphreysville, Ct. These articles have been brought to great perfection by the makers.

No. 274. *One Case of Stocks, Dies and Taps.* I. Sloat. The Committee considered these very good, and awarded the Diploma of the Institute.

No. 276. 1 *Set of Coach Springs.* Henry C. Jones, Newark, N. J. A superior article, and entitled to the particular attention of the public, as well as the Silver Medal of the Institute.

No. 173. *Traphining Instrument, and* 4 *Pairs of Razors.* C. A. Zeitz. The Surgical Instrument here exhibited is certainly a very beautiful specimen of workmanship. The absence of the ingenious inventor prevented a better knowledge of its applicability. The notice of the professors of surgery is invited to it. The Committee award the Silver Medal of the Institute.

No. 177. 4 *Boards of Brass Ware.* M. W. & J. A. Emmons. For the excellence of this Ware the Committee award the Diploma of the Institute.

No. 200. 1 *Concave Screw Auger.* Wheeler & French, 18 Pine street. The Committee consider this a very valuable article, and one which they cannot commend too highly to public notice. They award the Silver Medal of the Institute.

No. 214. *Patent Graduated Diamond-Point Pens.* George Williamson, 270 Division street.

No. 250. 1 *Clock Main Spring,* 2 *Chronometer do.* 1 *Lever and* 1 *Lepine do.* Desaules & Clerc, 27 Madison street. These were most excellent specimens of American workmanship, equal, if not superior, to any imported. The manufacturers should be patronized in this new article. The Diploma of the Institute.

MUSICAL INSTRUMENTS.

No. 60. 1 *Grand 7 Octave Piano Forte,* and 1 *do.* 6 *Octave do.* Bridgeland & Jardine, 338 Bleecker street; sold by Otto Torp & Co. Broadway. The latter of these was distinguished for mellowness and sweetness of tone, and considered the second best exhibited; for which the Committee awarded the Diploma of the Institute.

No. 89. 1 *Piano Forte—grand action.* John Abbot, 66 Walker street. The Silver Medal of the Institute. The Committee consider this instrument possessed of great brilliancy of tone, pleasant touch, and made in a superior manner.

No. 151. 1 *Bass Double-slide Trombone,* 1 *Kent or Keyed Bugle,* 1 *Keyed Trumpet,* 1 *Tenor Trombone, and* 1 *Slide Trumpet.* John Rosenberk, Utica, N. Y. Though there was no competition in these articles, the Committee are gratified in stating that, in addition to their own judgment, they have that of some of the best performers in this or any other country, for saying that these specimens have never been surpassed by any of the kind, either for tone or workmanship. They award the maker the Silver Medal of the Institute.

No 165. 1 *Piano Forte*—clutch-round cornered. A. G. Smith.

PRINTING AND BOOK BINDING.

No. 20. *Fancy Card Printing.* By C. L. Adams. These were uncommonly beautiful specimens, and quite equal to engraving. The Diploma of the Institute.

No. 49. *Specimens of Xylographic Engraving.* Wright & Prentiss, 45 Maiden Lane. Considered beautiful specimens of the art. The Silver Medal of the Institute.

No. 65. 1 *Rotary Printing Press—for Cards.* Charles F. Voorhies, Newark, N. J. The Committee think this Press extremely ingenious, and admirably adapted for the printing of Cards. The originality displayed in the invention, and the rapidity with which it executes work of this kind, is deserving of general, as well as of our own particular notice. The Silver Medal of the Institute.

No. 117. 6 *Blank Books.* David Felt, 245 Pearl street. The specimens of Binding here exhibited are of superior order in the taste with which they are got up, the elegance of their style, and the strength of their workmanship. The spirit of enterprise manifested by the manufacturer, in producing specimens like these, the Committee think deserving special notice from the public. They award the Silver Medal of the Institute.

No. 126. 5 *Boxes Printing Ink.* M. P. Prout, 63 Spring street. These specimens are so well known as not to need commendation from the Committee.

No. 25. 1 *Printing Press.* James Maxwell, 259 Bowery, N. York. Considered an excellent press both for the perfection of its work, and its simplicity.—The committee were much pleased with it, and awarded the Diploma of the Institute.

No. 148. 4 *Specimen Books of Types,* 16 *Pages of Types, and a Furnace in use casting Types.* George Bruce & Co. New-York City. These books exhibited the great perfection and beauty to which these manufacterers of types and typographical ornaments and illustrations have brought the art.

No. 254. *Specimens of Bookbinding.*—Coolidge & Lambert, 65 Wall street.—These were very good specimens of work.

No. 109. 1 *Bible.* Charles A. Focke. For exhibition.

No. 273. 2 *Composition Rollers.* J. Thomas. For exhibition.

FINE AND ORNAMENTAL ARTS.

No. 3. *Astral Lamp, Candlesticks, Writing Stands, Portrait Frame, Shirt Studs, &c., &c., made of Anthracite Coal.* From E. W. Kirk, 233 Chesnut street, Philadelphia. By Anderson & Ward. The Silver Medal of the Institute. These specimens were considered by the Committee superior, in point of workmanship, to any articles of the kind ever exhibited in this country.

No. 10. *Imitation of Quincy Granite.* A. Kent, 100 Concord street, Brooklyn, N. Y. A very fine specimen of imitation.

No. 15. 2 *Pieces of Sculptured Quincy Granite.* A. Lawrence. Very good workmanship. The Silver Medal of the Institute.

No. 16. *Pantographic Drawing of Chief Justice Marshal.* Wm. L. Ormsby, 142 Nassau street, New-York City. Considered of superior merit. The Diploma of the Institute.

No. 19. *Transparencies and Blind.* W. I. Hannington. Considered extremely beautiful. The perfection to which Mr. Hannington has brought this art does him great credit. The Committee have awarded the Silver Medal of the Institute.

No. 22. *Ionic Capitals*—two specimens of Carving in Wood. Luff &, Monroe, 105 Elm-st. New-York City. Finely

executed. The Diploma of the Institute.

No. 25. 12 *Specimens of Penmanship.* By Isaac Geward. Exhibiting much industry.

No. 46. 19 *Specimen Imitations of Rosewood, Mahogany, Marble, &c.* The *Mosaic Table Top,* in this collection, was inimitably fine, and worthy of the admiration uniformly expressed by visitors. Executed by George Bird, 94 Anthony street. The Silver Medal of the Institute.

No. 48. *Two Framed Designs.* By G. Thomas, 37 Canal street, New-York. The one representing a magnificent Viaduct and Bridge across the East River, from Brooklyn to New-York, the Committee think indicative of no ordinary talent in the young artist, by whom it was executed. The Bridge is supposed to have a row of Stores on either side; and the abutments and arches, 6 in number, to be of granite, except the central one, which is designed to be of cast iron, 180 feet high.

No. 61. 1 *Painting of a Dog's Head.* William Malbone. The Committee considered this a picture of superior merit, exhibiting great freedom in penciling and boldness of touch, for which they award the Silver Medal of the Institute.

No. 64. 1 *Painting of St. John.* John Alebon, 94 Anthony street, New-York City. The execution of this was thought to be good.

No. 74. *Framed Specimen of Carving.* Mr. Heron, 419 Water street—Frame executed by Mott & Stuart. The ornamental work is very ingeniously wrought, and with much labor.

No. 84½. 3 *Framed Engravings.* Geo. Endicott, 359 Broadway. Considered very spirited Drawings, and well executed. The Diploma of the Institute.

No. 88. *Framed Samples of Clinton's Patent Cement.* Deposited by N. H. Gale.

No. 116. 11 *Specimens of Penmanship.* John W. S. Mackie. The Committee are of the opinion that Mr. Mackie's specimens of writing are distinguished by a free and intelligible style.

No. 246. 1 *Framed Drawing, City Hall, Brooklyn, N. Y.* Wm. Brown.—This Drawing did the artist much credit, particularly on account of its shading.

No. 222. 1 *Vase of Shell Work.* John Lee. The Diploma of the Institute. The Committee are induced to invite public attention to this article, from the great merit it is said to possess, by those who have used it, for the walls of buildings; inasmuch as it is both very beautiful and lasting. From its great hardness, it is susceptible of being washed, like marble, without affecting its polish. Patented. Mr. Charles Clintón, West Town, Orange co. N. Y.

No. 93. 1 *Specimen of Needle Work,* (Mater Creatoris,) 1 *Bell Rope* and 1 *Lamp Stand.* Mrs. Hardrop, 3 Roosevelt street. The first of these articles, wrought with silk by the needle, is considered by the Committee of extraordinary merit; exhibiting both great skill and uncommon industry. They are not surprised that it received, as it deserved, the uniform expressions of admiration from the visitants at the Fair: they therefore award to the lady the Silver Medal of the Institute.

No. 113. *Case of Shell Work and Birds.* John Lee, 271 Broadway, New-York City. These specimens of ingenious workmanship the Committee consider very flattering evidences of the taste and skill of the artist; they therefore award the Diploma of the Institute.

No. 119. *Specimens of Penmanship.* William Jones, 183 Broadway. The style of these specimens is particularly free and bold, and, in these respects, worthy of special notice.

No. 183. 1 *Large Glass Punch Bowl.* Birch & Scarlett, 12 Liberty street. This massive article, from the truly beautiful manner in which it was cut, and the richness of its pattern, was particularly admired by all who saw it. The Committee take pleasure in awarding the Diploma of the Institute.

No. 147. *Pedestal of Scagliola.* Patrick Foley. The almost perfect resemblance of this to marble, both in touch and color, with the beautiful polish which it possesses, has received particular attention from the Committee. The Diploma of the Institute.

No. 153. *Statue of Napoleon Bonaparte, in Brown Stone.* David White, 80 Charlton street. The execution of this specimen of sculpture, by a journeyman stone cutter, does the artist much credit.

No. 156. 1 *Case of Artificial Teeth.* James Alcock. The Committee were particularly attracted to these specimens of a useful and ornamental art, by the

great perfection of the enameling; a point not sufficiently considered in estimating the value of artificial teeth. They award the Diploma of the Institute.

No. 157. *Specimens of the Mending of Lace.* Mrs. Heath, No. 8 Hester street. It is with no common satisfaction the Committee recommend this art to public notice. The rents in the specimens exhibited, though large, could scarcely be detected by the closest examination. The Diploma of the Institute.

No. 162. *Specimens of Pantographic Engraving.* T. S. Woodcock. These specimens prove that this valuable branch of the arts, though somewhat new, has been brought to a degree of elegant perfection. The Committee award the artist the Silver Medal of the Institute.

No. 178. 2 *Framed Drawings.* J. Davis. The taste and art displayed in these Architectural Drawings, together with the effective management of the lights and shades, readily show them to have come from the hand of a skilful artist. The Diploma of the Institute.

No. 192. 1 *Colossal Bust of McDonald Clarke.* James V. Stout. The truth of the likeness, and the superior finish of this specimen of modelling, the Committee think entitles this to more than ordinary notice. It will have appeared to all who have seen it that, in addition to the likeness and finish, it is in perfect keeping, and replete with the spirit of life. It has not been surpassed, if equalled, by any specimen of the kind in the country. The fact that this is the second effort at modelling from life by this young artist, and yet that the relative proportions, the character and perfection of anatomical developement, has been so wonderfully preserved in every delineation, goes further to prove his talents in the minds of mature judges, than our public expression of praise. The Silver Medal of the Institute.

No. 195. *A Bank Note Plate.* C. P. Harrison. Considered good.

No. 219. 6 *Specimens of Scagliola.* J. W. Clark. These specimens were extremely beautiful, and particularly admired by the Committee for the variety of their colors, and for the ornamental purposes to which the article may be applied. They award to the manufacturer the Diploma of the Institute.

No. 231. 2 *Vases of Artificial Flowers, made of Feathers.* J. B. Fisk, Brooklyn, N. Y. The Committee would make mention of these beautiful specimens, for the almost perfect resemblance they have to the natural flower; they display much ingenuity and skill.

No. 241. 1 *Framed Specimen of Needle Work.* Alfred N. Brewer.

No. 244. 1 *Framed Specimen of Penmanship.* F. W. Williams.

No. 255. 3 *Specimens of Bank Notes.* Casselear, Durand & Co. The execution of these notes were in the well known good style of the engravers.

No. 257. 1 *Design of the Chapel of the N. Y. University,* 1 *do. of City Hall, Brooklyn.* A. J. Davis. These designs were in the best style of the artist, so well known as an architect in this city. The tone of shading and truth of perspective, were particularly admirable. The Silver Medal of the Institute.

No. 275. 2 *Shell Card Racks.* Miss Shipman. For exhibition.

No. 281. *A Basket and Box of Grecian Ornamental Glass.* Miss Minor. Thought by the Committee to be very neat, and creditable to the lady's taste and skill.

No. 283. 6 *Looking Glasses.* Ed. S. Hill, 130 Chatham street. The Glasses were excellent.

No. 288. 1 *Map and* 3 *Engravings.* Wm. J. Mullen, 175 Broadway. For exhibition.

No. 164. *Architectural Drawings.* John Mitchell. For exhibition.

No. 199. 2 *Specimens of Penmanship.* J. A. Lee, 18 Pine street. For exhibition.

MISCELLANEOUS.

No. 12. *Specimens of Tool Handles.* By N. Couenhoven. Considered good.

No. 17. *Miniature Ship.* Capt. Bissel, 368 Broadway, New-York City. A good model.

No. 18. 31 *Specimens of Pottery from the Salamander Works.* Deposited by M. Lefoulon, 62 Cannon street, New-York City. These are beautiful specimens, and the Committee feel justified in saying that they have seen nothing to equal them in this country. In articles of this kind, where competition is so successfully prosecuted with the foreign article, the special notice of the public is merited by the enterprising manufacturers. The Silver Medal and Diploma of the Institute.

No. 21. *Type Moulds*. Mr. Abbys. Highly finished, and apparently very good. The Diploma of the Institute.

No. 30. 1 *Rifle Walking Cane*. A. D. Cushing, Troy, N. Y. Considered a very ingenious and important instrument, and finished in the most workmanlike manner. The Silver Medal of the Institute.

No. 34. *Castor Frames, Lamps, Candlesticks, of Britannia Ware*. I. Weeks & Co. Poughkeepsie, N. Y. Very good and highly finished.

No. 45. *Cork Mattress, Spring do.* and *Cork Bag*. John L. Norwood, 240 Water street. The Committee consider them very good, and worthy of special notice from those who use such articles.

No. 54. 11 *Samples of Snuff*. B. L. & H. Joseph, 138 Front street, New-York City. Diploma of the Institute. The Committee consider the quality of these specimens very superior, and in this they were borne out by the *olfactory* evidence afforded by visitors.

No. 55. *Naval Bombshell—Patent*. Dr. Scudder, New-York City. Cast by Johnson & Geer, Troy, N. Y. and the spikes wrought by Burden & Knower, of Burden's Patent Spikes. This is eminently calculated to effect the destructive purposes for which it was designed.

No. 58. 1 *Beer Pump and Cask*. D. F. Sergent, 40 Fulton street, Brooklyn N. Y. This is a self-supplying Double Power Pump, with little friction, and well suited to the purposes of Bar Rooms, Cisterns, &c. It is also well adapted for the uses of Wine, Cider, or Porter Bottlers, as it will empty casks without disturbing, in the least, the sediments therein.

No. 97. 2 *Printed Table Covers*, and 1 *Piano Cover*. Duncan & Cunningham. Considered of great beauty and firmness of texture. The Diploma of the Institute.

No. 100. 250 *Scripture Gems*. Colton & Jenkins. Considered very well executed.

No. 121. 8 *Specimens of Children's Clothing*, viz. 4 *Suits* and 4 *Tunics*. Mr. Durando, 60 Chatham street. Many of these were considered by the Committee very beautiful, and got up in fine taste. The Diploma of the Institute was awarded.

No. 75. 1 *Fancy Reel, for Winding Silk*. S. H. Platt, 128 Spring street, New-York City. Considered a very useful article.

No. 77. 2 *Boxes of Spermaceti Candles*. Samuel Judd. These were extremely beautiful, and not surpassed by any in the country. The Diploma of the Institute.

No. 78. 1 *Bed Quilt, of* 3,180 *pieces*. Lydia Todden. Considered a beautiful article, and the result of much labor.

No. 128. 1 *Pair Jacks*. 2 *do. Cards*. 1 *Machine Card*, 3 *Shuttles*, 1 *Cleaner*, 3 *Bobbins*, 1 *Side Lace Leather*. John Whittemore, 66 Frankfort street. The Cards and Shuttles were considered by the Committee of superior workmanship, and the *Lace Leather* as possessed of extraordinary merit, and think that it will come into great use.

No. 129. 6 *Pieces Mole Skin Buffalo Cloth*. Peter H. Schenck, 35 Pine street, New-York City. These were thought by the Committee superior articles, and highly meriting public attention. The Diploma of the Institute.

No. 131. 4 *Pieces Carpeting*. G. W. & G. Betts, 434 Pearl street, New-York City. All these specimens were considered good, but that of the Venitian Carpeting was thought to be very heavy, and in pattern and workmanship particularly excellent. The Diploma of the Institute.

No. 155. 3 *Coffee Urns*, 1 *Egg Codler*, 1 *Tea Pot*, 1 *Water Dish and Cover*. James Grant, 315 Broadway, New-York City. These are considered by the Committee of superior workmanship; they therefore award to Mr. Grant the Diploma of the Institute.

No. 161. 1 *Pair Window Blinds*. Francis Baker, 366 Hudson street.

No. 168. 3 *Fishing Rods and* 1 *Reel*. John Conroy. Considered good articles.

No. 175. 1 *Pair Ottomans, Foot Stool, Lamp Mats, &c. &c.* Mrs. Shultz, 45 Lispenard street. Some of these specimens were considered by the Committee extremely beautiful, and highly creditable to the lady who wrought them. The Diploma of the Institute.

No. 181. 4 *Port Folios, or Manifold Writers*. James Gilchrist, 102 Broadway, New-York City. The utility of this contrivance for copying Letters, &c. the

Committee think to be generally known. The Diploma of the Institute.

No. 174. 1 *Brass Trip, or Counter Scale*. W. H. & S. Nichols. Remarkable for its convenience.

No. 115. 3 *Trusses and Case*. Dr. A. G. Hull, 132 Fulton street. The Committee think this instrument admirably adapted for the purposes described; they award the Diploma of the Institute.

No. 186. 3 *Pairs Mantle Lamps*, 2 *Stand do.* and 1 *Astral do.* Samuel Wignall. These were beautiful patterns, and very richly ornamented with cut glass. The Committee awarded the Diploma of the Institute.

No. 198. 1 *Travelling Trunk*. Orlando Williams, 6 Norfolk street. Considered the best specimen offered, and of excellent workmanship. The Diploma of the Institute.

No. 203. 2 *Lamp Stands and Case*. Mrs. Whatmough. These specimens for competition were considered deserving the Diploma of the Institute.

No. 208. 1 *Frame of Castings*. Jones Kiem & Co. The Committee thought these very good, and meriting the Diploma of the Institute.

No. 229. 1 *Patent Coffee Roaster*. G. H. Clark, 4 Fletcher street. This was thought to be very convenient and durable, wherefore the Committee awarded the Diploma of the Institute.

No. 234. 1 *Cherry Stone, containing* 24 *dozen Silver Tea Spoons*. Charles Smith. This exhibited great skill and ingenuity.

No. 264. 1 *Speaking Trumpet*. Colin Lightbody. Considered very well made, and entitled to the Institute's Diploma.

No. 266. *Apparatus for Injecting the Veins*. Dr. J. Mauran. This is for injecting liquids into the veins, and is an appendage adapted to a self-injecting apparatus. It consists of a glass bulb with tubes fitted with screws, so as to be attached to Mob's self-injecting instrument, and so constructed as to prevent the possibility of the passage of air into the veins. The Committee think the instrument superior to every other for the purpose, and therefore award to the inventor the Silver Medal of the Institute.

No. 267. *Dahlia Flowers*. William Prince & Sons. The Committee are under special obligations to Mr. Prince for the splendid flowers which he sent to grace the exhibition hall of the Institute.

No. 291. 2 *Specimens of Fire Works*. Reuben Rider. The Committee thought the pieces very good, and they were much admired by the large company of spectators at the closing of the exhibition at Castle Garden, when Mr. R. made a very brilliant display of the pyrotechnic art. He was awarded the Diploma of the Institute.

No. 280. 1 *Fancy Musket*. John Mullen, 187 1-2 Greenwich street, N. Y. The Committee think this made in the neatest and most workmanlike manner. They award the Diploma of the Institute.

No. 285. *Specimens of Sealing Wax*. Lewis & Co. The Committee consider this the best article they have ever seen of the kind, foreign or domestic. The fancy colored wax in this large collection, does credit to the manufacturers, and should, with all the kinds here exhibited, receive the attention of the public. They award the *Diploma of the* Institute.

No. 72. 1 *Waggon*. Walters, Barre & Co. Brooklyn, N. Y. A fine specimen of workmanship.

No. 105. *Samples of Mustard*. J. Cogswell, 77 Canal street. For exhibition.

No 130. *Model of Patent Metal Roofing*. John Woolley. For exhibition.

No. 170. 1 *Tin Trunk*. L. Lester, 213 Water street, New-York City. This was a new and ingeniously made article, and one which the Committee particularly noticed.

No. 85. *Pen and Ink Drawing*, 1 *Etching*, 1 *Engraving of Ornamental Iron Work, and* 1 *Frame of Cards*. W. M. Thompson, 167 William street, New-York City. For exhibition.

No. 188. 1 *Ship in Case*. Wm. Scarle. For exhibition.

No. 218. 1 *Churn*. Justin Ware.

No. 235. 1 *Miniature Rail Road and Clock*. W. S. Jacks. This was an ingenious piece of work, and was in operation during the Fair, to the delight of the visitors. For exhibition.

No. 247. 1 *Bed Quilt*. L. R. Sweetland. For exhibition.

No. 249. 1 *Bottle, with Reel of Silk*. For exhibition.

No. 263. 1 *Glass Hive*. Mr. Kelsey. For exhibition.

No. 270. *Map of the United States.* James McChesney. For exhibition.

No. 278. 1 *Door Weight.* Dr. Davidson. For exhibition.

N. 24. *Sea-Horse Hide.* Remarkable for thickness.

No. 260. 1 *Framed Oil Painting.* D. Avigney, 183 Broadway. This specimen had no inconsiderable merit.

No. 230. 1 *Large Tabular Plate,* and 16 *Lights of Glass.* New-York and Brooklyn Crown Glass Company. This Company was incorporated in 1832; capital $60,000; employs 50 hands, and produces 10,000 feet of Glass weekly; their Factory is in Brooklyn, near the Navy Yard. The quality of this Glass was considered by the Committee most excellent. The *Plate* was of great dimensions, with equal clearness and uniformity in thickness. The Diploma of the Institute.

STOVES.

No. 282. 1 *Summer Cooking Stove.* Charles Vale, Newark, N. J. This was a superior article, and adds to the reputation of Mr. Vale, as a manufacturer of Stoves.

No. 47. Sent for exhibition.

No. 13. 1 *Parlor and* 1 *Cooking Stove.* Sylvester Parker, Troy, N. Y. Beautiful and convenient articles. The Diploma of the Institute.

No. 27. 1 *Cooking Stove.* Seth Lowe & Co. Made by Mr. Town, Salem, Mass.

No. 56. 1 *Cooking Stove — of Sheet Iron.* Charles Vale, Newark, N. J. Considered a most ingenious arrangement for domestic purposes, whilst it is admirably adapted for an economical appropriation of heat. The Silver Medal of the Institute.

No. 101. 1 *Stove.* James Hinds, 200 Canal street, New-York City. The Committee consider this a very handsome article. The Diploma of the Institute.

No. 122. 3 *Coal Cooking Stoves.* Joel Curtiss, 222 Greenwich street. Considered very neat and useful articles. The Diploma of the Institute.

No. 166. 3 *Cooking Stoves,* 1 *Fancy and* 1 *Parlor do.* Jordan L. Mott, 248 Water street. The Committee consider the two last mentioned stoves novel and useful.

No. 185. 2 *Rotary Stoves and Fixtures.* M. N. Stanley & Co. The ingenuity displayed in the structure of these, and their utility, entitle them to the Diploma of the Institute.

No. 139. 2 *Cooking Stoves,* 1 *Globe do.* Doyle & Patterson, 213 Water street. For exhibition.

No. 146. 1 *Coal Cooking Stove,* 1 *do. for Heat.* S. C. Lawrence, 125 Broadway, New-York City. For exhibition.

No. 27. 1 *Cooking Stove.* Seth Lowe & Co. 211 Pearl street. Wm. Town, maker, Salem, Mass.

No. 66. *Doric Fireplace and Minerva Grate.* Wm. Mallory, Agent. The Committee highly approve of these articles, both for their model and workmanship, combining, as they do, great neatness and utility: the Grate is admirably adapted for the burning of anthracite coal. The Committee award the Silver Medal of the Institute.

No. 79. *Spoor's Patent Coal Stove and Scuttle.* J. F. Clarkson, 51 Fulton street, New-York City. Considered very good and very neat. For the Stove the Committee award the Diploma of the Institute.

APPRENTICES' WORK.

No. 4. *Two Mantle Lamps.* Made by James McGovern, New-York City, an apprentice one year. Considered very good. Privileges of the Institute.

No. 5. *Two Astral Lamps.* William Moore. Considered very good.

No. 11. 2 *Pictures.* George Heister, aged 15.

No. 14. 1 *Cask.* George Thompson, aged 18 years—1 year, an apprentice—55 Goerck street, New-York City. Deserving great praise. Silver Medal and Privileges of the Institute.

No. 28. 1 *Iron-bound Cask.* James Flinn, an apprentice, 19 years old, 3 years at trade. Diploma and Privileges of the Institute.

No. 39. *Frame of Cards.* By James Everdell, 135 William street, N. Y. C., a boy aged 15 years. The Silver Medal and the Privileges of the Institute.

No. 50. 1 *Iron-bound Barrel.* James Thomas, an apprentice; 2 years at trade. Privileges of the Institute.

No. 51½. *Gentlemen's French Boot Lasts.* Those in Box No. 3 were made by a boy 14 years old, to whom the Committee award the Privileges of the Institute.

No. 85. 1 *Case of Jewelry.* George

Street, an apprentice, 18 years of age, 3½ at trade. The Diploma and Privileges of the Institute.

No. 90. 1 *Case of Surgical Instruments*. James Turkington, 51 Clinton street; an apprentice, 18 years old. The Silver Medal, and the Privileges of the Institute. The Committee are of the opinion that the case of Surgical Instruments, here presented, exhibits talents and zeal in the maker worthy of being stimulated to further exertions, and that these specimens of his workmanship are of surpassing elegance and finish.

No. 136. 1 *Silk Hat*. James Patterson, 94 Canal street—1 year an apprentice with Mr. John Wright. Considered, from the short experience of the maker, an uncommon evidence of skill.

No. 137. 1 *Clock Stand, and* 1 *Marble Ink do.* Wm. Patterson, 33 Canal street, 3½ years an apprentice to Mr. Barnes. Considered excellent work. The Privileges of the Institute.

No. 150. 1 *Leather Travelling Trunk*. Geo. Dupignac, 28 Hester street, nine months an apprentice to O. Williams. The Committee take pleasure in noticing the early efforts of apprentices, and this specimen is one among those to which their attention has been called. The Privileges of the Institute.

No. 73. 2 *Tables*. Joseph Fisher, 15 years old; an apprentice 1¼ years. The Diploma and Privileges of the Institute. These specimens certainly gave great promise of talent in the young mechanic, and were duly appreciated by the Committee.

No. 155. To Wm. Taylor, an apprentice, 19 years of age, manufacturer of a *Coffee Urn*, the Committee award the Privileges of the Institute.

No. 240. 3 *Carpenter's Ploughs, and 7 Spare Irons*. Isaac Battie, Providence, R. I., 18 years old, apprentice 3 years to J. R. Gale. The superiority of workmanship displayed by this young man, in the make of these articles, entitles him, in the opinion of the Committee, to the Silver Medal of the Institute.

No. 53. 5 *Ladies' Straight Lasts*. R. Coit, a lad 16 years of age; 1 year at the trade. The Privileges of the Institute.

No. 87. 1 *Carved Ionic Cap*. Samuel Smith, aged 16 years. Well executed.

No. 152. 1 *Engraving of McDonald Clarke*. Lewis P. Clover, aged 16, first attempt, 6 months at trade. Considered an evidence of uncommon merit in his business, and therefore worthy of the Diploma and Privileges of the Institute.

No. 84. *Machine for Corking Bottles*, made by Augustus Williams, an apprentice, deposited by F. Groening. Privileges of the Institute were awarded to the apprentice for the workmanship, which was excellent.

No. 91½. 3 *Pairs Pocket Compasses*. By Gerrett Barney, 16 years of age. Apprentice to Brown & Hunt. These have much merit. A Diploma, together with the Privileges of the Institute, have been awarded to the apprentice.

During the evening which closed the Fair of the Institute, Dr. Gale made several brilliant and interesting experiments, with the Institute's powerful Galvanic Battery. The combustion of Charcoal, and Platinum, displayed an intensity of action, power of heat, and vividness of light, which astonished the numerous auditors. The light was altogether too dazzling for the sight, and could be viewed only a few moments at a time. The combustion of metals in water was not the least interesting to the ladies and gentlemen present, who repeatedly manifested their surprise and gratification, during the performances, by loud and cheering applause.

The novel exhibition of *Walking upon the Water* was also presented from the Garden to thousands of our citizens during the Fair of the Institute. Mr. Macintosh, the successful experimenter, entered the water near the Battery, and walked a considerable time in the North River, sustaining himself in an upright position, and moving with much apparent ease, though the surface of the water was agitated by rough and high waves. This experiment satisfactorily proves the importance of the simple apparatus used on the occasion, for fording rivers, and for preservation against accident.

GEORGE BRUCE, HENRY CUNNINGHAM, WILLIAM PARTRIDGE, HENRY DURELL, JOHN M. DODD, ADAM HALL, JOHN BELL, W. H. HALE, J. S. REDFIELD.	Committee on Premiums.

FAIR OF THE AMERICAN INSTITUTE.

This splendid display of that spirit which is constantly urging our yet infant nation still onward in the march, or rather flight of improvement, has now closed; and it is not enough for us merely to say, it has not only exceeded the most sanguine anticipation of the most enthusiastic American patriot, but it has surpassed any thing which could have been believed, had it been predicted. The official Report is in detail before the public; but we deem it not only a privilege, to which we are entitled, but a duty we owe to our readers to present them, in our own way, our own opinions, comments and remarks, if not on every article, at least on some of those we considered most particularly worthy of notice.

In estimating the respective value of the productions of human ingenuity and industry, we should place in the first rank, and at great distance before any others, those which increase the *productiveness* of human labor. He who, by his ingenuity, can contrive, in any branch of labor, in which ten thousand people are employed at one dollar per day, to produce the same effect by the labor of one thousand, or ten times the effect produced before, by the ten thousand; if he does not deserve all the increase his ingenuity has produced, he certainly deserves, and well deserves, an immense pecuniary reward, together with the grateful thanks and the cheering applauses of mankind. But it is painfully true that exactly the reverse is generally the case. The authors of far the greater number of labor-saving inventions have met no reward but poverty and contempt.

The next in order of merit is he who, by his ambition to excel, produces the fairest and most improved specimen, or the greatest quantity, of any article contributing to the comforts, or the innnocent pleasures, of life. The agriculturist, who can exhibit the most improved article in his line, either animal or vegetable; or the manufacturer, who produces the most valuable sample of cloth, or any other manufactured article, ought, certainly, to be rewarded and respected accordingly; but no person of sense will contend that the man who produces the largest and fattest ox or swine, or the finest and best article of clothing, can rank, in the scale of merit, with him who has contrived means to make the same labor, in produing these articles, yield ten or a hundred-fold.

The next degree of merit, we consider, (though our judgment may by some be called in question,) belongs to the persons whose genius and refined taste serves to increase and improve the embellishments of life.

With these remarks, we shall give our notices of the various exhibitions at the Fair accordingly.

LABOR-SAVING INVENTIONS, AND IMPROVEMENTS IN MANUFACTURES.

Shaw's Patent Threshing Machine and Horse Power.—Presented by T. L. Pollard & Co., Albany. There is probably no other branch of labor which has been the subject of so many patented inventions as Threshing; and there are so many constructed on the same leading principles, that it would be impossible to tell with any certainty, which is entitled to preference, or for the patentees of a dozen or twenty, to point out how their respective Machines differ from all the rest. But it is a fortunate circumstance, that those of late invention are nearly or quite all good. Mr. Shaw's is among the number, and for aught we can see, as good as any. The Horse Power seems to present the greatest difficulty, and in this, we think Mr. Shaw's as good, and perhaps better, than any others; as it will operate with as much certainty, with as little power, and at less expense, and being less complicated, is less liable to disorder; and we are not afraid, therefore, to recommend it to any farmer.

Fitzgerald's Grinder, and Threshing Machine.—This Grinder consists of the frustrum of a cone, of French burr, which runs on a horizontal axis in a conical hollow case of the same material, which is in two halves, the one stationary and the other moveable. We saw it in operation by a single horse power, and it made flour of the first quality, and we should say half as fast as a common grist mill,

with a full head of water. It must need be an excellent article where large grinding establishments cannot conveniently be come at, and for many uses where they can.

The Threshing Machine is a good one, but we shall make no comparisons in that article.

Walter Hunt's Patent Forest Saw.—We cannot better describe this article than in the inventor's own words. "A simple, effective Machine, designed for felling trees and cross-cutting their trunks for lumber; and also, for the purpose of clearing wild lands." We consider this an article of peculiar value for the following reasons: First, we are confident trees may be felled with it as fast, and we think faster than with the axe. Second, It may easily be carried and used by one man,—its weight being only 30 lbs. Third, It will cut nearer the ground than can conveniently be cut with an axe, and of course leave the stumps lower. Fourth, By felling trees with the axe, the trunks are often split near the ground, and valuable timber spoiled, which will not be the case in sawing. Fifth, Its cheapness puts it within the reach of every man engaged in lumber.

Throstle and Speeder, for Roving and Spinning Cotton.—Made at the Oldham Works, one mile from Paterson, N. J., under the direction of B. Brundred, and exhibited by Samuel G. Wheeler & Co., 42 Pine street, New-York.

These Machines exhibit some improvements in the principles of their construction; but the points which most strongly recommend them, are excellency of workmanship and materials, in both of which they are truly elegant, without superfluity; and we do not believe they can be surpassed in correctness of operation.

Washing Machine.—Invented by A. W. Soule, and *another*, by William Niffin.

We have seen many patent Washing Machines, and each declared by the inventor or vender, to be far superior to any other. We will venture to say, that the two above mentioned are both good, and probably that they are equal to any we have seen.

Improved Drill,—made by D. B. King, of Waterford. The importance of a discovery is in no direct proportion to the magnitude of the object discovered. This little diamond is worth a whole quarry of granite, though the latter is valuable; and in such proportion we consider the value of this little invention of the Drill. Every good Mechanic will feel the same pleasure, when it meets his eye, that a skillful connoisseur in the article would feel on finding a valuable diamond.

Machine for Making Staves,—invented by Philip Cornell, of New-York. As a *hand labor saving* invention, we have some doubt whether this Machine has any superior; and it does its work in a style which hand labor cannot imitate, without an immense sacrifice of time. It not only finishes, ready to put together, of any suitable timber, from 200 to 400 Staves per hour, and which need no dressing off, after they are set up; but it effects a vast saving of timber, as one Stave is taken in its finished state, directly from the side of another, without any intermediate waste.

Machine for Cutting Lath.—We can truly say of this Machine, that for operativeness, simplicity, and cheapness, it can hardly be surpassed. It cuts from 60 to 80 Lath per minute, and as they are cut off smooth at one stroke with a sharp tool, their quality is improved, and there *is no* waste, even of a saw-calf.

Improved Clock,—made by George Gaines, at Seneca Falls, and exhibited by E. W. Adams, the Proprietor. We had neither time nor opportunity to examine in detail the improvements in this beautiful specimen of Clock work. But we saw enough *to* convince us, that its plan *is superior* to any other now in use, as an accurate time keeper, either for private houses, or for churches and other public buildings, and we hope and trust that both the inventor and the proprietor will meet liberal encouragement from the public, which we think they certainly merit.

Improved Theodolite,—made by Ewin & Keartte, Baltimore. Invented and exhibited by Samuel Stone. We cannot do justice to this splendid invention, as well as elegant specimen of workmanship, in the brief com-

logue we are giving, so well in any other way, as to let the inventor speak for himself—we therefore give his own words.

"This Instrument embraces all the principles of a Modern Theodolite: besides which, it contains the following improvements—The first improvement is a circular revolving plate, sliding or resting upon the limb of the instrument. The upper surface of which forms a plane with the upper surface of the limb; on which are delineated a set of Mathematical numbers, which supply the place of a Table of Logarithms, and all other logarithmic tables.

"In the second place, this Instrument is so constructed as to supersede the necessity and use of a Chain in all cases. The distance of any visible object can be ascertained at one station, as far as a flag staff can be distinctly seen through the Telescope of the Instrument, to the exactness of chains, links, and decimals.

"It also calculates the Latitude and departure of every course run, and the base and perpendicular of all elevations. It further embraces all the fundamental rules of common Arithmetic, viz: Multiplication, Division, Single Rule of Three, Interest, Mensuration of Superfices and Solids, Gauging, &c. Any question in plain Trigonometry, right angled or oblique, can be solved on the Instrument correctly; including all questions that can be performed by Logarithms or Logarithmic Tables. The whole without the use of figures or a mathematical calculation."

Cheese Press, invented by S. Kibbe. This is the best plan of a Cheese Press we have ever seen.

Mowing and Grain cutting Machine, invented and exhibited by Capt. Alexander Wilson.

In estimating the value of this labor-saving Machine, it is necessary to consider the quantity and quality of the labor saved by it. It is well known that cutting down grass and the different kinds of grain, is far the hardest and most extensive, as well as expensive branch of labor in the whole catalogue of farming operations; and that it has to be performed at the critical moment when in season; and the farmer is often, thereby placed at the mercy of his hired laborers, who always charge a higher price for it than for other labor, and at times take undue advantage of the employer's necessity.

Now, if this Machine answers the intended purpose, and we can see no reason why it should not, the farmer, instead of complaining, that though the "*harvest is plenteous, the laborers are few*," can dismiss eleven of his twelve laborers; saving not only all their wages and food, but all the liquor they drink; or, if he feel a charitable disposition to employ the poor, he can by the money so saved, extend his fields to ten or twelve times their present size, and increase his stock, and consequently his wealth, accordingly. Capt. W. calculates that this Machine, with a man and horse, will do the work of twelve men in cutting either grass or grain. His plan appears to be simple and well digested; and if it should be susceptible of improvements, as he is himself a farmer, there can be no doubt that the head which has conceived the plan thus far, will be able, by the light of experience, to perfect what appears, at least to us, to be so ingeniously begun.

Machine for Sawing and Jointing Shingles, invented by David B. Moore.

We have seen several Machines for sawing and jointing shingles not very dissimilar, possibly the same. We think, however, this has some improvements; at any rate, this is a good Machine. The exhibitor states that it will make 10,000 shingles per day with a 5 horse power, which is probably the case. It would, therefore, in a place where there is plenty of timber, and a sufficient water power, be a valuable and profitable article. The cost is $100.

Double-Acting Bellows, invented by Chs. D Holmes.

This will be a valuable article, where a continuous and steady blast is wanted, either on a large or small scale. It occupies but little space, is not expensive, and cannot fail to effect *the purpose*.

Locomotive Chair, for people incapable of walking. By James Grey, Brooklyn.

This is a valuable invention for persons unfortunately deprived of the power of

walking. It is a handsome mahogany chair of compact size, and the machinery by which the person moves it with either hand, is not only simplified to its lowest terms, but is truly ornamented. Mr. G. is, as far as we know, the first who constructed such a chair, and his improvements are the result of 15 years' experience.

Double-acting or Continuous Pump, for the use of houses, stables, &c. By Dudley L. Farnham.

This article is not new, though the patent has not yet expired: we have known it some years, and still know it as an excellent article.

Patent Churn. By Francis Lane.

This was the most simple looking article exhibited at the Fair; and yet we presume not only every lover of good butter, but every one who recollected as we well recollect, the many and painful hours spent in boyhood at the tedious labors of the Churn, when ever and anon, the relaxed sinews of industry received new stimulus from the cheering (not to mention fretting) admonitions of the good mother, prompting us to perseverance, and who saw this Churn, must have felt, as we felt, a peculiar glow of satisfaction as he passed it. We have seen patent churning machines tortured into every earthly shape except that of a real Churn, and adapted to all sorts of purposes but churning; but this was none of them. It was no machine at all, nothing but a couple of the real old churns of the days of our childhood, and each making the other go of itself, without the application of any power which would tire a child.

Patent Roastmeat Jack, made by Edward Shepherd, Paris, Oneida county.

This is a very ingenious and simple contrivance to turn, by clock work, a spit for roasting meat. When cooking is done on a large scale, we should consider it a very valuable article.

Improved Shears, made by David Ward.

These Shears, which were exhibited in a case with a lot of the most elegantly finished Shears we have seen, were on a plan which we should think a very great improvement, where several thickness of cloth are to be cut through at once. By a combination of levers, so light and so ingeniously contrived as to be no more unwieldy to the hand than common shears, a power is gained sufficient to cut through forty thickness of cloth without straining the hand.

Morticing Machine, invented and exhibited by George Page, of Keene, N. H.

This is one of that family of inventions which seem actually combining together to turn labor into sport, and at the same time, to increase its productiveness as if by magic. It has been exhibited in operation most of the week, morticing table legs, bedstead posts and other articles—made 16 mortices in a minute—makes them straight or circular, or oblique to any angle; will mortice a 14 spoke hub in 5 minutes, and all with more accuracy and neatness than those made by hand.

The price of the Machine, with a set of 6 chisels, is $30. He has also a machine for making mortices in framing a building, with nearly the same despatch. We should think no man, whose business embraces making mortices in wood, would be long without one.

Another *Morticing Machine*, by Richardson and Dennis, is doubtless a good article, but we did not see it in operation. But a little the most marvellous specimen of labor saving, or rather labor annihilating, we saw, was a brace of

Machines for making Biscuit, made and exhibited by J. & C. Bruce.

One of these Machines is for large and the other for small biscuit. The small one is calculated to mould in the most perfect manner, and to bake and complete at the same time 48 in a *second*, or 2880 in a minute, or to go a step farther into the marvellous, 162,800 in an hour. Or, to tell the whole story in few words, he will, in one hour, convert about 18 barrels of flour into good and wholesome bread. The baking part of this Apparatus was not exhibited at the Fair. We are, therefore, not authorized to vouch for the report of this part of the invention. Of the rate of moulding we had occular demonstration. The inventor as-

sured us that his plan comprehended the baking as well as the moulding, and that he had it perfectly matured, though it was not exhibited.

To pass over all other considerations on the Bread-Making Apparatus, we should think its importance at sea, and in war, enough to enrich, if not immortalize its inventor. A given quantity of flour takes up less room in storage than the same baked into bread. In long voyages at sea, instead of barely preserving the spark of vitality, by gnawing upon a dry and mouldy substance, which, perhaps, was once bread, but is now the habitation of myriads of noisome insects, the health of a crew will no doubt be promoted, independently of the comfort, by good and wholesome bread every day, or at farthest once a week; and the same benefits will result to an army on land.

The whole expense of this wonderful Apparatus, sufficient for a ship of the line, will not exceed $100, and the space it will occupy is so small as to be of no consequence. Who can tell why this does not meet with encouragement?

Arnold's Patent Machine for Making Twisted Roving.—The several inventions for making Rubbed Roving, and the preference given to that kind of Roving, except for fine twist, have nearly superceded the use of Twisted Roving altogether in this country. But in spinning cotton from 60 hanks to the pound upwards, Roving is doubtless to be preferred with some twist; and as we are constantly progressing towards finer fabrics, we think this speeder may become a valuable article. Such is the opinion we formed, in the absence of any one to explain it.

Hamilton's Machine for Sawing down Trees.—This article stood in the Fair by the side of, and of course in competition with, that of Hunt, and we noticed the preference alternately given to each, by the multitude who examined them. But these opinions weighed nothing with us. We assume the right to judge for ourselves. There were some strong points, respectively, in favor of each. Cheapness and portableness were in favor of Mr. Hunt's Machine. The effect of the fly wheel, to equalize the resistance to the power applied, was in favor of Mr. Hamilton's. The former is the application by hand, aided by a lever, and spring of the saw, directly to the tree. In the latter the saw hangs upon a frame, swinging upon a pivot, operated upon by a crank and fly-wheel, and pressed forward to its work by a weight. We shall appeal to the decision of time and experience, for a decision as to their relative value.

Blowing Machine.—This is an ingenious contrivance, by Mr. Brundred, of the Oldham Works, near Paterson. It consists of the frustrum of a cone surrounded with spiral fans, which being inclosed in a conical shaped case, the air is converged and forced out at the small end with any force, according to the propelling power. It will prove a useful thing.

Model of a Spiral Reacting, or Tub Water Wheel. This is one of a numerous family of Water Wheels, varying but little from each other, and which we think is as good as any we have seen of the kind. They are importantly useful in certain situations.

Improved Stoves.—This is a very important subject, and worthy to engage, as it has engaged, the most eager emulation. But the competitors are so numerous, and so many important improvements have been exhibited, that it would be difficult if not impossible to award the victory with justice to any one. At this Fair there were 80 different stoves exhibited. The preference in this department of invention has been generally given, and we believe justly, to Dr. Nott. But it seems impossible for one man to run so fast in any race but that another may equal him. We had not an opportunity to examine critically the merits of each stove, but we think the claims of Mr. James Wilson, of Mr. Parmalee, and of Mr. Parker, entitle them to a candid examination.

Bee Hives.—Among the numerous useful improvements, we saw none more entitled to patronage than the bee hives, exhibited by Messrs. Parish and Kelsey. Both their plans were good. We were instructed and amused by the practical knowledge of Mr. Kelsey on the subject, a degree of knowledge which few men would have patience to

acquire; we intend to profit by Mr. K's instructions, but we prefer the hive exhibited by Mr. Parish. We hope the labor and examples set by these gentlemen, will put an end to the shameful pratice of destroying these industrious little creatures with fire and brimstone.

Printing Press.—The hand Printing Press of M. L. Kingsley, embraces some improvements in simplicity and facility of working; and notwithstanding the overwhelming importance of the double or single Napier Press, we think this still has its usefulness, and is entitled to respectful notice.

MANUFACTURES.

As it is proper to commence with the most valuable articles, we will select *Mr. Pemberton's Improvement in Gold.* Mr. P. has succeeded in effecting a perfect and solid union between pure gold and pure copper, and between 18 carat gold and a composition very suitable for various purposes, in so perfect a manner that a bar plated and drawn down will answer an infinite number of purposes, in all respects as well as solid gold. The Buttons exhibited by Mr. P. manufactured in this way, are in all respects, for use and beauty, superior to buttons of real gold, as the metal on which they are plated is more substantial, and all that can be seen is gold. The same, when plated on both sides, may be said of the Watch Cases—and we might add, many other articles.

Silver Ware.—The specimens of Silver Ware exhibited by Mr. Marquand, 181 Broadway, and Mr. James Thompson, 129 William-st., produced the most agreeable astonishment, especially to us, who well remember when to produce a common Silver Buckle in this country, was a thing viewed with utter astonishment.

Articles of Copper.—We saw several elegant aritcles of Copper, which we thought quite as worthy of attention, and as useful as those of gold or silver, though the material did not cost so much.

We will next notice some articles chiefly of Steel and Iron, which we consider to be of still more intrinsic value than those made of any other metal.

We will begin with the beautiful specimens of *Edge Tools*—consisting of Chissels, Gouges, Drawing Knives, Broad Axes, &c. &c. Superior in finish to any imported ones we have seen, and we trust no less so in temper, as they were manufactured by Kennedy & Way, of Hartford—in the senior member of which firm we recognize an old friend, whose ingenuity, in that line, as well as honesty and patriotism, we have witnessed in days of "*Lang Syne.*"

The *Wood Screws*, by Messrs. J. G. Pierson and Brothers, are far superior to any imported articles of the kind we have seen.

The Case of elegantly finished *Shears*, of somewhat varied descriptions, but above all the pair with increased power which we have already described, are elegant indeed.

Another valuable item was *Hinges*, of various descriptions—a most superb article.

Door Locks—and various other articles composed of metal, all of which were superior to any thing of a similar nature which we have been accustomed to meet with.

Watch Dials, of rich and superior beauty, by Mr. Mullen, 175 Broadway.

Sheet Brass, manufactured at Waterbury, Connecticut—a very important article, and of excellent quality.

Sheet Zink, in very large sheets.

Razors, Penknives, Shears, and other Cutlery, in as high perfection as ever graced a show-case, by Robert Ward, 142 Fulton-st.

Another sample, of similar character, by William Wild, 142 Fulton and 162 Division street.

Augers, and various instruments for boring, of the most improved form, and exquisite workmanship.

A splendid lot of Joiner's and Cabinet Maker's Tools, such as an ambitious young man might feel proud to work with, and such as twenty years ago were never seen on this side of the Atlantic, and perhaps rarely on the other, by A. & E. Baldwin 404 Broome street.

Scales and Scale-beams, of the most approved forms and finished workmanship, by D. H. & S. Nichols.

In the line of *Clothing*, we can only say collectively—there was a universal assortment composed of every material, except

Silks, which we have every reason to believe will form a brilliant climax to the display another year. The exhibition of *Broadcloth, Cassimere, and other Woollen Goods*, left apparently but little room for future improvement. One piece of Black Cloth in particular, without any disparagement, to the rest, was for excellency of finish, and particularly for its silky softness, a proud article for our country, or any other. It was made by C. A. Beecher, Waterbury, Connecticutt.

In *Cotton Goods*, the display was highly respectable, consisting not only of almost every article of undyed Cotton in use, but of dyed and printed Goods, of exquisite beauty. The printed Muslins and dress, and furniture Calico, from W. Robertson, of Fall River, did credit to the Manufacturer, and to the country.

The *Cut Glass*, from W. T. Morton, of Baltimore, was as near perfection as our fancy can reach.

The specimens of *Bookbinding and Blank Ruling*, were beautiful indeed—if they can be surpassed it would be needless.

The various articles of *Cabinet Furniture*, some displaying superior workmanship—some improved form, and ingenious contrivances for convenience, and some both, were well worth their price, to those who can afford to buy them, and a gratifying treat to us who could not.

With respect to the *Piano Fortes*, and other stringed as well as wind Instruments, we can only say, in general terms—they were a superb display, but we were not surprised nor astonished, for we expected to find them so. It is to be feared they have left no room for improvement another year.

We must not forget, as a specimen of American manufacture, a *Bolt of Duck*, a most substantial and well finished article, by our valued friends Amos Briggs & Co. Scaghticoke.

Various articles of *Indian Rubber* were exhibited, which were not only valuable in themselves, but much more peculiarly so, as they pointed to an immense, but yet unexplored field of future improvements, of which that article is to form the foundation. The little net-covered globes, or parlor balls, exhibited by H. Percival & Co. must certainly furnish an all-important hint to the Æronaut. But at any rate, we have no fear in predicting that the hundredth part of the uses of this long neglected article have not yet been thought of.

The specimens of *Crown Window Glass*, from Redford, and from Brooklyn, certainly bid defiance to any other country in that line. As they stood in a bad light, we could not decide which was entitled to the preference, if either; but either of them far surpassed any imported Crown Glass we ever saw.

There were some beautiful specimens of *Swords*, but as we profess to belong to the *peace party*, we hope they will never come into general use.

Relief Bed for the Use of the Sick.—Among the numerous and successful displays of inventive genius, we saw nothing which merited more grateful applause, or a more liberal reward, than the above article, invented by Mr. Jones, of Providence, R. I.

Mr. J. states that he has been employed a great number of years in attending on the sick, and that the plan he has presented has been suggested by necessity, and improved and directed by his long experience, and it may be truly said his services confirm his statement, and do credit to his genius.

By this wonderful contrivance, whilst a sick person may be lying horizontally and asleep on it, the upper part of the bed may be elevated to any angle required, and, if necessary, lowered again to the same position—or the patient may be raised from the bed altogether, and swung off by a crane, at the head of the bed, while the bed is made, and then put back on a fresh made bed, and all this without sufficient jar to awaken the patient from the most delicate and watchful sleep.

Whenever the state of the patient requires, or admits of sitting in a chair, the bed may be immediately transported into an easy chair, and back again in a moment, when required, to a bed, in so gentle a manner as not to give pain even to a broken limb. Should the patient be delirious, even to the most raving maniac, this same soft bed is in an instant made to supercede the use of the straight

jacket, by confining the body, head, and even the limbs, in the most perfect stillness, and without the slightest pain; and in addition to all these conveniences, the necessary calls of nature may all be attended to with the most perfect cleanliness, and without the slightest movement of the patient.

Who would not be willing to reward so much ingenuity applied to such a purpose?

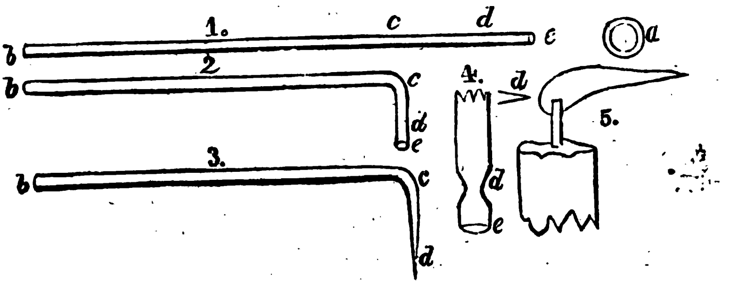
We have now enumerated, with occasional remarks, those articles which we thought most important; especially the most useful. To go into an entire detailed description of the several hundreds of fancy and minor articles, though many of them were useful, and all perhaps displayed ingenuity, and a spirit of enterprise which deserves encouragement, yet we think it would occupy too great a portion of our pages, which our readers would decide might be appropriated to better use.

We shall notice, when we have leisure, and room in our pages, some of the foregoing articles, more at length, and give engravings in cases where we can obtain them.

[From the London Mechanics' Magazine.]

On the Practice of the Blow Pipe.—The introduction of the use of the blow pipe in practical chemistry, may be regarded almost in the same light as the application of the power of steam to the purposes of commerce. If the latter has increased our national resources, and forwarded the interests of mechanical science, by economising the labor and expenditure which were formerly bestowed, the former has, in like manner, advanced the cause of chemistry, and its dependent sciences, by reducing the expense of fuel, time, and material, which were originally required in qualitative analysis. If the mechanic can now produce, with comparative ease and expenditure, an article which, before the introduction of the steam engine, would have required the labor of many weary days, and the consumption of much valuable material,—the modern chemist can, with equal facility, detect the constituent principles of a body, which, before the invention of the blow pipe, would have called in requisition the unremitting exertions of many tedious nights, and the profuse employment of many rare, and, perhaps, valuable substances. In fact, by the introduction of this simple, yet invaluable instrument, the modern chemist can, by his parlour fireside, and with a common candle, perform those operations, to accomplish which, the ancient and less gifted philosopher would have been compelled to resort to the unhealthy atmosphere of a laboratory, and the continued poring over an intensely active fire. The blow pipe, according to Bergman, had been long employed in the arts by jewellers and others, for the purpose of soldering, before it was applied to the purposes of analytical chemistry and mineralogy, by a Swedish metallurgist, of the name of Sual, about the year 1733. This individual, however, appears to have left no written account of the method which he adopted in the application of this instrument. The researches of Cronstedt, Bergman, and Gahn, and, more recently, those of Berzelius and Faraday, have concurred in raising this instrument to the eminent station of utility which it at present enjoys. In the work of Berzelius on this subject, will be found ample instructions for the pursuit of mineralogical and analytical chemistry; and in the "Chemical Manipulations" of Dr. Faraday, the student will meet with copious directions for applying this instrument in the bending and blowing of glass, in practical chemistry. For the former purpose, the mouth blow pipe possesses undeniable advantages; but for the more fatiguing operations of the latter, the table, or hydrostatic, blow pipe will be found convenient. The advantages possessed by the mouth blow pipe over all those instruments whose blast is produced by artificial means, consists in its portability, economy, and the facility of *immediately suspending* or *modifying the blast.* "The chemist does not possess," says Dr. Faraday, "a more ready, powerful, and generally useful instrument, than the mouth blow pipe, and every student should early accustom himself to its effectual use and application."

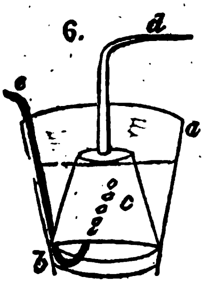
The supply of a *continued* stream of air, is the chief difficulty which a beginner experiences in learning the use of this instrument, and this difficulty is, I apprehend, not unfrequently increased by the employment of a blow pipe with too large an orifice, in the first instance. The



following method of constructing, will, I have reason to believe, be found more efficacious than any other hitherto published, since I have, by its means, succeeded, in less than half an hour, in communicating the art of blowing to a class of several persons. Let the pupil procure a tube of glass, *b e*, about thirteen inches long, and of the size and thickness of *a*. Let him now thoroughly heat the tube at *c*, about two inches from the end, by slowly turning it round in the flame of a candle, or, what is better, a spirit lamp. When he finds that it will yield, let him bend it gradually till it has acquired the position represented by fig. 2. The part *d* is now to be heated in the same manner, till it is found soft enough to draw out, when the part *e* must be gradually withdrawn, as represented in fig. 4, till it terminates in a point; this point should be held for a minute or two in the point of the flame, in order to thicken it, and when cold it is to be ground away with a file, until the smallest possible orifice is visible. The pupil will now be possessed of a blow pipe (fig. 3,) with an exceedingly minute jet; and if he puff out his cheeks to the utmost, and place the end *b* within his lips, while the other extremity is held within a short distance of a candle, (fig. 5,) he will, after a few trials, find no difficulty in keeping the flame *continually*, and *without intermission*, horizontal and clear. The operation which he will be required to perform, in order to keep his cheeks constantly distended, notwithstanding the escape from the jet, cannot easily be described, but will naturally offer itself when the expenditure of air is very small. When the pupil has succeeded in keeping up a constant blast for several minutes, by this means, he may enlarge the aperture by degrees, practising between each enlargement, till he finds he can manage a blow pipe with a large bore, when he should purchase one of brass, with an ivory or tinned mouth piece, for general use.

Among the numerous hydrostatic blow pipes which have already appeared in your Magazine, the pupil who wishes to manufacture his own apparatus, may assuredly find one which will form a substitute for the table blow pipe. I subjoin a plan for one, which may be constructed, at a trifling expense, by almost every student, and in situations where the articles of workmanship requisite for the construction of a more complicated machine, could not be procured.

6.



a b (fig. 6,) is a common pail, about half filled with water; *c* is a large flower pot, inserted, and fastened in by any convenient method; *d* is a mouth blow pipe, (glass would do on an emergency,) fastened in air tight, with a cork and lute, to the hole at the bottom of the flower pot; *e* is a bent tube of glass, or metal, terminating under the mouth of the flower pot. When air is blown in from the mouth at *e*, it rises into the body of the internal vessel, and displaces the water, which, in endeavoring to regain its level, forces out the air from the jet of the blow pipe, with a force proportioned to the height of the column of water displaced.

The length of the *paved* streets in England and Wales is 20,000 miles; that of the roads which are not paved is 100,000 miles. The extent of the turnpike roads is about 30,000 miles.

[From the London Repertory of Patent Inventions.]

Specification of the Patent granted to JOSEPH GIBBS, *of Kennington, in the County of Surrey, Engineer, for certain Improvements in Carriages and in Wheels for Carriages.*—Sealed November 4, 1834.

WITH AN ENGRAVING.

My invention of certain improvements in wheels for carriages consists in a peculiar arrangement of the spokes and naves of wheels, whereby wheels may be constructed with greater facility as will be hereafter fully described.

Description of the Drawing.

Fig. 1, represents a wheel constructed according to my improvements, which I prefer first to describe.

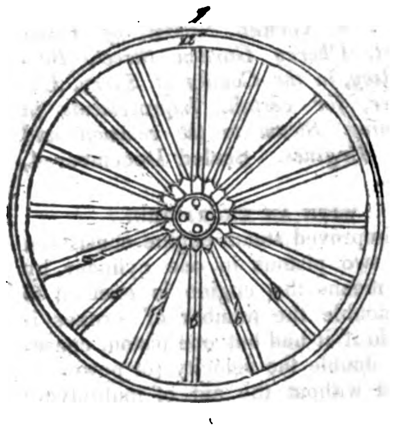
Fig. 2, is an edge view in section.

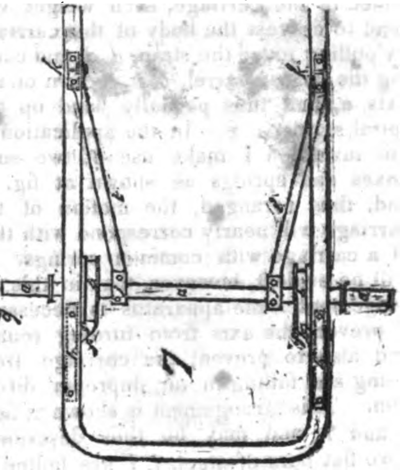
Fig. 3, shows the nave in section, which is of metal. This nave also constitutes the axletree box.

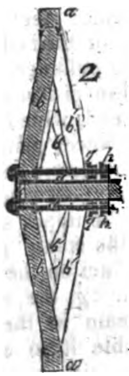
Fig. 4, shows part of a wheel in section in order to shew the arrangement of the spokes. In each of these figures, (1, 2, 3, and 4,) the same letters indicate similar parts, *a*, *a*, being the felloes of the wheel, there being mortices cut in them to receive the ends of the spokes, as is clearly indicated in the drawing at fig. 2. *b*, *b*, are the spokes which it will be seen stand at an angle to each other, and each two (proceeding from opposite ends of the nave) appear when the wheel is viewed edgeways to form the two sides of an isosceles triangle, of which the nave represents the base; but it will be seen that the spokes are inserted at equal distances from each other in the felloes, and they are alternately placed at the two ends of the nave, as is very clearly shown in fig. 2, and the ends of the spokes are slightly hollowed out in order to abut against the axletree box which constitutes the nave of the wheel. *c*, is a plate formed on the outer end of the axletree box, *d*. The spokes may be so formed at the ends which come against the axletree box, *d*, that they just fill in and wedge one another, as shown in fig. 4, or there may be longitudinal grooves cut or cast on the outer surface of the nave or axletree box. *e*, *e*, are screw bolts which retain the parts of the wheel together, and also hold the axletree within the axletree box, as will be hereafter fully described. *f*, is a washer which lies against the plate, *c*. It will be seen that the spokes, *b*, which project outward from the felloes come against the plate, *c*, and the spokes, b^1, which project inwards are retained in their position by the plate, *g*, and this plate is held to its proper position by the screw bolts, *e*, *e*, by means of the nuts, *h*. The axletree, *i*, has a collar, *j*, formed thereon, and by means of the plate, *k*, the screw nuts, *l*, and the screw bolts, *e*, *e*, the axletree is held within the axletree box, *d*, as will be evident on inspecting the various figures in the drawing.

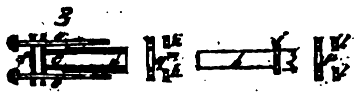
Having thus described the various parts of the wheel, when constructed according to my invention, it is necessary to point out more particularly the peculiar novelty of the construction which constitutes the invention secured by the above recited letters patent. It will be evident, that as any two succeeding spokes, b, b^1, may be said to form the two sides of an isosceles triangle, the axletree box or nave, *d*, forming the base of such triangle, if the plate, *g*, be made to approach the plate, *c*, the spokes, b^1, will approach the spokes, *b*, that is to say, they will approach more nearly to the perpendicular, which will tend to expand the circumference of the felloes, and make the whole wheel most rigidly secure, and thus in case of the spokes becoming loose, the wheel may be made firm by merely screwing up the plate, *g*: and it may be remarked, that a wheel constructed according to these improvements, may be repaired in much less time, and at less expense, than when wheels formed in the ordinary manner, for it will only be necessary to remove the plate, *g*, sufficiently to take out any faulty spokes and replace the same with others and then to screw up that plate, *g*, and the wheel will be again complete.

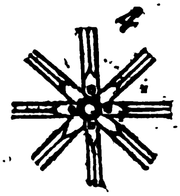
Fig. 5, represents a different arrangement for expanding the spokes and felloes. The spokes which are shown edgewise and in part at *a*, *a*, are all placed in the same plane, and held in their places by the plates, *c*, *c*, and bolts and nuts, *d*, *d*, *d*, *d*. If the spokes were arranged so as to form a smaller cone at their interior end than that at the exterior of the box, *e*, *e*, it is evident that by screwing up the nuts on the bolts, *d*, *d*,

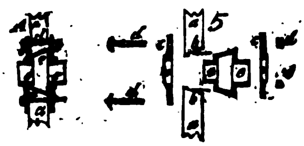












the cone, *e*, *e*, would be forced through the conical hole formed by the spokes, and thereby push the whole of them outwards towards the felloe, and so produce an expanding action outwards. The box and spokes when screwed up would appear as at *a*, fig. 5.

Having thus described the nature of my invention of certain improvements in wheels for carriages, and the manner of carrying the same into effect, I would have it understood that I lay no claim to the various parts of a wheel, which are well known; but I do hereby confine my claim of invention to the arranging of the spokes so that they are capable of expanding out the fellees, and thereby offering great facilities in constructing as well as in repairing wheels so formed.

And further, as relates to my improvements in carriages, the same are ascertained and described by reference to the drawings.

Figs. 6 and 7, which represent such parts of a carriage as are necessary to explain my invention, the same letters of reference are applicable to both these figures. *a*, is the axletree of the carriage. *b*, *b*, is a box or barrel (shown at fig. 6, with one of its ends removed to exhibit the interior,) which contains a spiral spring, *c*, *c*, one end of which is attached to the axis, *a*, and the other to the box, *b*, *b*. The action and construction of this spring, therefore, is similar to the main spring of a watch. Round the preriphery of the barrel, *b*, *b*, is wound the leather strap, *d*, *d*, *d*, attached to the barrel at the point, *e*, and to the supporting rod, *f*, *f*, at *g*, which supporting rod is bolted to the shafts (or any convenient part of the carriage) at *h*, *h*.

It is evident, therefore, that if weight be added to the carriage, such weight will tend to depress the body of the carriage by pulling round the strap, *d, d*, and causing the box or barrel, *b, b*, to turn on the axis, *a*, and thus partially wind up the spiral spring, *c, c*. In the application of this invention I make use of two such boxes and springs as shown at fig. 7, and, thus arranged, the motion of the carriage will nearly correspond with that of a carriage with common springs. It will be evident, however, that in this arrangement some apparatus is necessary to prevent the axis from turning round, and also to prevent the carriage from rising and falling in an improper direction. This arrangement is shown at figs. 6 and 7, and may be thus described. Two flat bars of steel, *i, i*, are bolted at one of their ends to the flaps of the axis at *j, j*, and at the other (by bolts) to the knuckle joints, *k, k*. By this apparatus, when the carriage vibrates upon its springs it will describe a curve represented by the red line, *l, l*, fig. 6, being a segment of a circle of which the bars, *i, i*, are the radii, and the kunckles, *k, k*, the centre. The motion of the carriage, therefore, is nearly vertical, and sufficiently so for practical purposes.

Having now described the nature of my invention of improvements in carriages, I hereby declare that I claim as my invention as far as relates to my improvements in carriages, the application of a spiral spring and barrel, as a substitute for the ordinary springs of carriages, and the mode by which the axis is connected to the body of the carriage, viz., by the radius bars, *i, i*; and though the parts individually may have before been used in machinery, yet I claim the whole as a new combination, forming an improved substitute for the ordinary springs of carriages. In witness whereof, &c.

Enrolled May 4, 1835.

New Steam-Engine.—It is said the Rev. W. Morris, minister of Deanrow chapel, Wilmslow, in Cheshire, has invented a new steam-engine, expense of erecting which will be less than a tenth part of the cost of a steam-engine of equal power, and the expense of working it will be less than one-thousandth part of the expense of working a steam-engine of equal power.

[From the Repertory of Patent Inventions.]

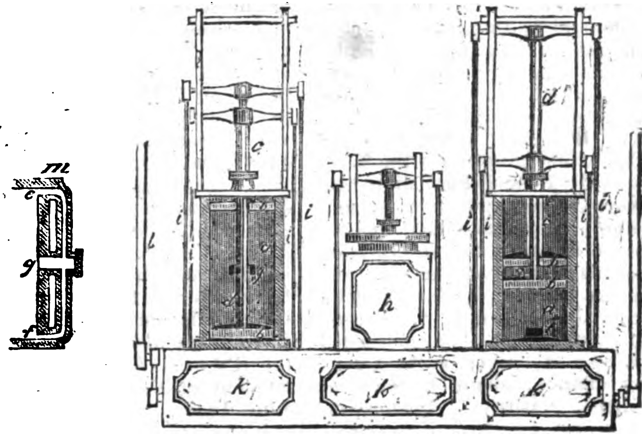
Specification of the Patent granted to William Alfred Noble, *of Cross Street, Cherry Garden Street, Bermondsey, in the County of Surry, Engineer, for certain Improvements in applying Steam to the common and other Engines.* Sealed December 4, 1834.

WITH AN ENGRAVING.

My improved steam engine consists in having two pistons in one cylinder, by which means the engine is enabled to make double the number of strokes it would do if it had but one piston, consequently double the velocity (or power) is obtained without the aid of multiplying wheels.

Description of the Drawing.

The annexed drawing is a representation of a perpendicular section of the cylinders for a pair of thirty-horse marine engines. *a*, the cylinder. *b, b*, the pistons. *c*, the hollow piston rod, with a stuffing box at the end, which admits of the piston rod to the lower piston passing through. *d*, the solid piston rod to lower piston. *e*, the steam port which admits the steam to act on the upper side of the upper piston, *b*. *f*, the steam port which admits the steam to act on the underside of the under piston. *g*, the steam port which admits the steam in the centre of the cylinder to enable it to act on the two pistons. *h*, the cistern which contains the air pump and the condenser. *i, i, i, i*, the connecting rods to the crank, *k*, by which the power of the two engines are united. *k*, the four throw crank, shown by the dotted lines running under the base of the cylinders and condensers. *m*, represents the steam ports above specified, as seen from the other side of the cylinders, and the steam is let on and off in the usual way. *l, l*, the connecting rods from the crank of the engine to the crank of the paddle wheels. The steam being admitted through the steam ports, *e*, and *f*, forces the pistons, *b, b*, together, the steam is then turned off into the condenser in the usual way, which is unnecessary to describe, at the same time the steam is admitted by the steam port, *g*, between the pistons, the one is then forced up and the other down: the above action is then repeated,



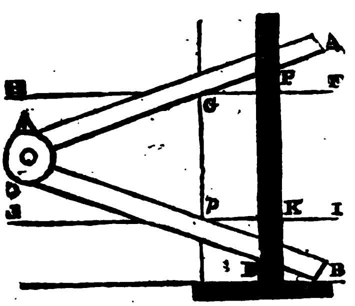
which being connected to the cranks by means of the connecting rods, *i, i, i, i*, the machine or paddle wheel is set in motion.

I would further observe, that I do not confine myself to the operation of two pistons in one cylinder, as more might be employed; but two appear to be sufficient. The same principle of two or more pistons in one cylinder is applicable to engines of high pressure principle. In witness whereof, &c.

Enrolled June 4, 1835.

[From the London Mechanics' Magazine.]

Simple Perspective Delineator.—Sir: It is a considerable time since I discovered, and reduced to practice, a ready method of putting plans into perspective, without drawing the usual lines, without finding vanishing points, and without any other trouble than using a very simple instrument with a little care. The following is a representation of the instrument, which is cheap, and is sold by the author.



Let A C B be a variable angle, to move in every position; H F a line for the plane of the picture; and L I a ground line parallel to it; other lines, parallel to the last, may be drawn for different elevations. Let P be any point whose perspective is required; place C A at P, and also a T square, whose side is P D; this done, move the leg C B until the line, I K, falls in the angle P K B; now move the T square into the position G *p*, so that the line G F comes into the angle A G *p*; then the point *p*, so found, will be the perspective of P. The principle upon which the instrument is constructed is, that the elements of perspective depends solely upon similar triangles.

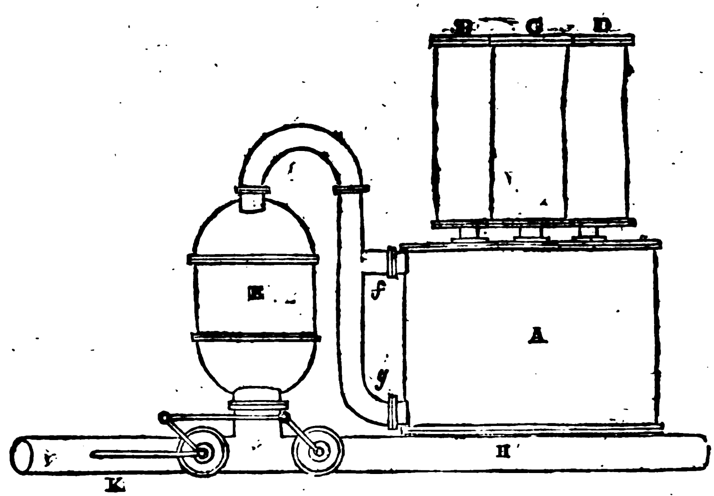
In the year 1821, I invented and made public that description of horizontal perspective called by me the Horizontorium.—The demand for it was such that it was sent for from all parts, and continued in request for four years. Very recently, this very invention has been reproduced by persons who would fain persuade the public that it has just come from France. Some have done even worse than this, for they have published new ones on false principles, and painted them in a manner which is a disgrace to science; any person desirous of seeing a specimen of this has only to look in at the Pantheon, in Oxford street. The horizontorium has nothing beyond common about it; the only peculiarity being that the view is projected on a horizontal plane, in lieu of a vertical one. One eye only should view the picture, and that eye be guided by a hole in a card. The same should be done in viewing every perspective representation, let its plane of projection be what it may.

I am, &c.

W. Shires.

Mr. Dean's Submarine Operations.—Mr. Dean has resumed his summer amusement of diving to the wreck of the

Royal George, or any other wreck, if requisite; hooking the first thing that becomes portable, and getting it hoisted out; he has already got up eleven very handsome brass guns, and three iron ones, exclusive of some cooking materials, a bottle of wine, and sundry small articles. Last week, upon a complaint made by some fishermen, that while at work on the West Flats, between Ryde and Fort Monkton, their nets were frequently broken by getting foul of some substance which was beyond their art to discover, this enterprising individual got his vessel over the spot, and descended to the bottom; he there found a large piece of ordnance stuck in the mud, and, by great exertion and labor, succeeded in getting it up. It proved to be a very perfect brass cannon, about fifteen feet long; the name, "Koster, Amsterdam, 1636," perfectly legible. The ornaments are most beautiful and chaste; the breech and trunnion are formed in a bunch of grapes. The metal is perfect, and rings as sound as a bell. The shot, on being drawn, peeled in flakes, but the wadding was in excellent preservation. Mr. Dean is of very great use here. The other day a French whaler left an anchor in the harbor which had got foul of the moorings: Mr. D. was employed to raise it, which he succeeded in doing, and got salvage accordingly. On groping further, he got hold of another anchor, worth 20*l*. He has fitted his vessel and boat for foreign service, and towards the autumn will proceed to Navarin Bay, to try his luck among the wrecks of the Turkish fleet.—[Portsmouth Correspondent of United Service Journal, 20th June, 1835.]



[From the London Mechanics' Magazine.]

PLAN FOR PROPELLING STEAM-VESSELS BY THE RETROACTIVE FORCE OF A COLUMN OF AIR.

Sir,—The above sketch represents a plan for propelling steam-vessels by a powerful current of air ejected from the stern of the vessel. Water has been tried in a variety of ways to effect a similar object, but I am not aware of any trial having been made similar to the plan proposed.

A is the cylinder of the air-pump, with three inverted steam cylinders on the top, marked B C D. The piston rods of the inverted cylinders work the plunger of the air-pump, and are attached to it at equal distances from the centre, and at equal distances from each other. The cylinder of the air-pump being 10 feet diameter, it is presumed that three steam cylinders so placed would be a better arrangement than with one in the centre, if even equal to the three in capacity.

E, an air-vessel, which the air is forced into at the passages *f g*, alternately, with each stroke of the pump. Those passages have valves to prevent the air returning into the cylinder of the air-pump.

H, a cast-iron pipe running from the prow to the stern of the vessel, and open at both ends to the water. There are two cocks or valves to this pipe, one on

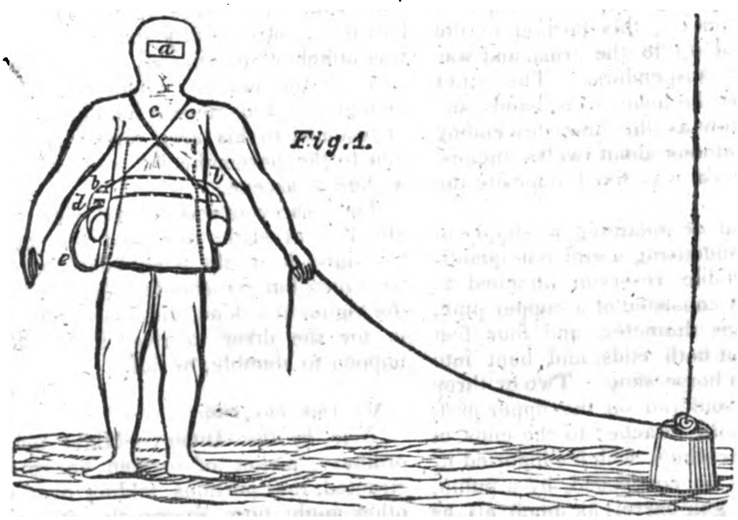
each side of the air-vessel. When the air is blowing off to propel the vessel forward, the lever K of the hand-gear is in the situation represented in the figure; when the lever is raised a little higher, the air will rush out at both ends of the pipe H, and neutralize the propelling force, and if raised a little more, it will be discharged at the prow of the vessel only. That a power of starting, stopping, and backing the vessel, may be thus gained, is obvious.

If we suppose the air discharged by the pump to be condensed to one-fourth of its original volume, and the cylinder of the air-pump to be 10 feet diameter, with a 6 feet stroke, making 18 strokes per minute, about 4,000 cubical feet of air would be discharged every minute from the stern of the vessel. *Question,*—What would the probable result of such an experiment be, as respects the velocity of the vessel so propelled, to the power expended, when compared with paddle-wheels?

I am, Sir, your very ob't serv't,

J. W.

April 24th, 1835.



[From the Journal of the Franklin Institute.]

Description of a Diving Dress, invented and used by Charles Condert, *of Brooklyn, New-York.*

TO THE COMMITTEE ON PUBLICATIONS.

Gentlemen,—The diving dress described in this communication, and the disaster connected with it, have been recalled to my recollection from noticing several recent patents for submarine apparatus. It appears to possess some peculiar features, and seems well calculated for small depth; no metallic or other inflexible material is used in its construction, or in connecting the two portions of it together. It is put on and off with the same facility as an ordinary dress, and, when in use, the body is in full possession of its natural flexibility of motion.

It was invented (and frequently used) by Mr. Charles Condert, a machinist, employed in a factory on the margin of the East river, in Brooklyn, opposite this city. In the docks adjoining the workshop, he repeatedly decended in it, in from sixteen to twenty feet water. While thus engaged, in August, 1832, he fell a victim to his enterprise. The air in the reservoir had become expended, or, from some accident, (probably by his falling,) it had escaped, as the tube that conveyed the air from the reservoir to the interior of the dress, was found broken, when hauled up. He was, of course, instantly suffocated.

Like Mr. Spalding, the improver of the diving bell, he perished in the bloom of life, at a distance from his family, and in

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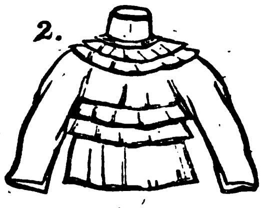

3.

the prosecution of his favorite pursuits. If a description of his dress be inserted in the Journal, it will probably be the only memorial of this ingenious, persevering, and unfortunate mechanic.

The dress consisted of two parts, made of cloth, coated with gum elastic; the under part was a pair of pantaloons, with India rubber shoes; this portion of the dress extended up to the arms, and was supported by suspenders. The other part embraced the head, arms, hands, and the body as low as the hips, descending over the pantaloons about twelve inches. A piece of glass was fixed opposite the eyes, as at *a*.

His method of obtaining a supply of air, was by condensing a sufficient quantity into a portable reservoir attached to the dress. It consisted of a copper pipe, *b b*, six inches diameter, and four feet long, closed at both ends, and bent into the form of a horse shoe. Two or three staples were soldered on the upper part, to receive hooks attached to the ends of suspenders, or slings, which supported it. Into this pipe he condensed, by a pump, (formed of a gun barrel) as much air as he supposed would be required for the time he intended to remain under water. A small valve cock, *d*, near one end of the reservoir, admitted air into the dress, when required; by opening this valve, a small pipe, *e*, from which entered two or three inches under the lower edge of the upper dress, or jacket, where it folded over the under part. The air escaping from it, of course, entered the dress, and kept it inflated, and prevented the water from entering it.

As the air was respired, it ascended to the upper part of the hood, or covering of the head, and escaped by a small aperture in the cloth, about the size of a pin's head, or less. He intended to use a valve in its place, but found it to act tolerably well. His situation below could always be preceived by people above, from the air ascending perdendicularly over *this* orifice.

The round part of the reservoir embraced his back, and the two ends projected in front, on each side of him.

When he descended, by a rope passed through a hole made in the bottom of a boat, sufficiently large, (about two and a half feet square,) a fifty-six pounds weight was attached to one end, and suffered to sink to the bottom; another cord, attached to it, and one end held in his hand, or fastened to his arm, served to direct him to the perpendicular rope, when he wished to ascend.

The reservoir was loaded with about 200 lbs. of lead; this load was placed too high; it would have been better to have distributed it about the legs and feet; the higher the load, the more difficult it is for the diver to rise, if he should happen to stumble, or fall.

T. E.

New-York, June, 1835.

Note by the Author.—Might not the ordinary jacket of seamen be so constructed, that portions folding over each other might form receptacles of air, sufficient to prevent them from sinking, when, from accident or otherwise, they fall into water, as is shown at fig. 2? or perpendicular cells might be quilted on them, as at fig. 3, without *materially* changing the present appearance of the dress. In almost every position in which a person could fall into the water, some air would remain in these cells.

Who is a Gentleman?—Coleridge, in his 'Table Talk,' thus describes a gentleman. It is a vivid delineation.

"Whoever is open, generous, and true; whoever is of humane and affable demeanor; whoever is honorable in himself, and candid in his judgment of others, and requires no law but his word to make and fulfill an engagement; such a man is a gentleman, and such a man may be found among the tillers of the earth."

[From the Journal of the Franklin Institute.]

Replies to a Circular in relation to the Occurrence of an unusual Meteoric Display on the 13th of November, 1834, addressed by the Secretary of War to the Military Posts of the United States, with other facts relating to the same question. By A. D. Bache, Prof. of Nat. Philos. and Chem., Univ. Penn.

(Communicated by the Author.)

Having found that the inference drawn from my observations on the morning of the 13th of November, 1834,* at Philadelphia, was directly opposite to that to which Professor Olmsted had been led, from his observations at New-Haven, I felt naturally desirous to determine what might have been the extent of country over which the unusual display of meteors seen at New-Haven had taken place, this extent having a direct bearing upon the question of the nature of the phenomenon. At my request, communicated through the kindness of the Chief Engineer, the Secretary of War, Gov. Cass, issued a circular to the commandants of the different military posts of the United States, requesting to be informed whether any unusual meteoric display had been witnessed at their respective posts, on the morning of the 13th of November, 1834.

The results of this inquiry, I propose now to put upon record, in as brief a manner as possible. The arrangement adopted in the record, is to begin with the most northern post on our north-eastern frontier, to pass southward along the Atlantic board; then beginning with the most southerly post of the western chain, to pass northward along that chain, then eastward on the northern frontier, towards the original point of departure. Along this line, the display of November 13th, 1833, attracted universal attention.

From Hancock Barracks, Holton Plantation, Maine, Maj. Clarke reports that no recurrence of the meteoric phenomenon of 1833, was observed on the 13th of November, 1834.

A similar report is made by Maj. M'Clintock, in relation to Fort Preble, Portland, Maine, and its vicinity.

No unusual meteoric phenomenon was observed at Fort Constitution, Portsmouth, New-Hampshire, as stated by Maj. Ansart; nor at Fort Trumbull, New-London, Connecticut, as stated by Maj. Saunders; nor at Fort Hamilton, New-York Harbor, according to the report of Maj. Pierce; nor at Fort Severn, Annapolis, Maryland, according to Maj. Walbach; nor at Fort Washington, Potomac river, below Washington city, according to Maj. Mason.

Maj. Churchhill states that at Fort Johnston, Smithville, North Carolina, no unusual meteoric appearances were noted on the evening referred to in the circular, but that no one was particularly engaged in watching for a recurrence of the meteors of 1833.

Maj. Gale reports from Fort Moultrie, Charleston Harbor, that he can find no one in the garrison, or its vicinity, who has seen any unusual meteoric display since November, 1833; and the report of Lt. Williamson, from Castle Pinckney, in the same harbor, is to the same effect.

Capt. Marchant makes a similar report from Fort Oglethorpe, Savannah, Georgia.

From Fort Marion, St. Augustine, East Florida, Capt. Drane reports that no recurrence of the meteors had been observed, and that no remarkable meteorological occurrence was recorded about the period designated, in November.

No recurrence of the meteors was observed at Fort Jackson, on the river Mississippi, below New-Orleans, commanded by Capt. G. M. Gardiner.

General Atkinson states from Jefferson Barracks, near St. Louis, Missouri, that no occurrence of the sort alluded to in the circular, was observed in the autumn of 1834, by "any one at the post, nor was there such a recurrence any where in the west, as far as [his] inquiries, had extended."

Lieut. Col. Vose reports from Fort Towson, on the Red river, below the mouth of the Kiameche, that no recurrence of the meteors had been observed, as far as he could learn, in the section of the country in which the post is situated.

Col. Dodge, commanding the regiment of dragoons, reports from Fort Leavenworth, on the Missouri river, at the junction of the Little Platt, that no remarkable meteoric phenomenon had occurred

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* See Am. Jour. Sc. & Arts, by Prof. Silliman, for January, 1835, p. 335.

since his arrival at the post, on the 27th of September; he adds, that "a recurrence of an event so remarkable as the one mentioned, could not have escaped the notice of the sentinel on post."

From Fort Snelling, Falls of St. Anthony, Upper Mississippi river, Maj. Bliss reports that, from an examination of the sentinels who had been on post during the night of the 12th and 13th of November, he could not learn that any recurrence of the meteoric phenomenon of 1833 had been observed. He gives a particular account of a very bright meteor seen at 5 o'clock, A. M. on the morning of the 9th of January, 1835.

Lieut. Col. Davenport, commanding at Fort Armstrong, Rock Island, Upper Mississippi river, Illinois, states, as the result of information which is satisfactory to him, that no meteoric phenomenon was observed on the 13th of November, 1834, at his post. He gives the temperature at 7 o'clock, A. M. on the 13th of November, as 42° Fah., the wind N. E., and the weather fair.

The reports from Fort Dearborn, Chicago, Illinois, commanded by Maj. Green, and from Fort Winnebago, portage between the Fox and Ouisconsin rivers, N. W. Territory, commanded by Lieut. Col. Cutler, state that no unusual meteoric display was noticed there on the night referred to.

The return from Fort Howard, Menomoniveille, Michigan Territory, is of the same purport, General Brooke adding, that there were several apparent shocks of an earthquake in Movember, 1834, as evidenced "by a severe rocking of the flag-staff in the night, although it was perfectly calm at the time."

From Fort Mackinac, Straits of Michilimackinac, Michigan Territory, Capt. Clitz reports that he has "made inquiry of the sentinels who were on post on the night of the 13th of November last, and *one* only, an intelligent young man, who was posted at the north angle of the fort, saw a shower of meteors in the north, between 12 and 1 o'clock, the duration of which, as near as he can recollect, was about one hour."

Maj. Hoffman reports from Fort Gratiot, on the St. Clair river, that no recurrence of the meteoric phenomenon of 1833 was observed at his post.

The returns just given are from eleven posts in the Atlantic States, from Maine to East Florida; from six posts in the Western States, or frontier, and from five on the northern frontier; they agree in stating, with one exception, that no unusual meteoric display was noticed on the night of the 12th, 13th of November, 1834.

It is almost needless to observe, that the military stations are places where observation of any striking meteoric phenomenon may be expected, at least one sentinel being on post, the reliefs being posted by a non-commissioned officer, and the sentinels visited at least once during the night by a commissioned officer. Vigilance is particularly to be expected in our out-posts, from which the reports are quite minute. A local "shower" of meteors was observed by a sentinel at Fort Mackinac, about midnight, and lasting about one hour. Many of the reports do not confine themselves to a statement that no meteoric display was witnessed at the posts, but include inquiries made in the vicinity.

These reports may, I think, be considered conclusive against the occurrence of any extensive and remarkable display of meteors, so far as ordinary observation could have detected such a display.

In reply to letters addressed to friends in different quarters, with a view to ascertain if special observation had been made on the morning of the 13th of November, I received the following information.

At New-York, as I learned from Prof. Renwick, a gentleman well known for his scientific attainments, assisted by a friend, watched the during whole night, but saw no remarkable occurrence of meteors. Doctor Gibbons, of Wilmington, Delaware, observed the heavens, in connexion with his observations on the aurora, until about half-past 12 o'clock on the morning of the 13th of November. He informs me that he has been in the habit of inspecting the heavens, frequently, every clear evening since November, 1833, and has observed, often, an unusual number of meteors, for several evenings in succession, and sometimes the reverse of this. The night of the 12th, 13th of November, 1834, was clear.

No unusual occurrence of meteors was

noticed at Baltimore by the city watch, or others, to whom inquiry was directed by Prof. Ducatell; nor at the University of Virginia; nor at the University of North Carolina; at which places, as I learn from Prof. Patterson, and Prof. E. Mitchell, no special observations were made. At Cincinnati, Ohio, the night was cloudy, with showers.

President Lindsley, of Nashville University, informs me that one of the gentlemen of the University was on the look-out on the night of the 12th, 13th, but saw nothing remarkable.

The direct observations made at New-York, Philadelphia, and Nashville, show that no unusual meteoric display occurred at either of these places; and the general experience at Baltimore, and Wilmington, Delaware, the University of Virginia, and the University of North Carolina, was to the same purport. As far as public testimony through the journals can reach this point, it confirms these conclusions.

I infer that the meteors seen at New-Haven, from one o'clock until daylight, by Prof. Olmsted, and the gentlemen who assisted him; at West Point, after 2, A. M. by Mr. Twining; at Mackinac, between twelve and one o'clock, by the sentinel, were not parts of one meteoric display, visible over an extensive region of country, like the phenomenon of November, 1833, but were local.

It is to be seen from the foregoing statements, that the weather was not the same over the extent of country which they embrace, while on the 13th of November, 1833, there was a most remarkable uniformity over a much greater surface.

Philadelphia, May 28, 1835.

[From the Journal of the Franklin Institute.]

On the Action of Hydro-chlorate Muriatic Acid Gas on Silver, at a high temperature. Theory of the Method of Parting in the Dry Way. By M. Boussingault.

(Translated for this Journal, by Jos. Wharton.*)

By the phrase *parting in the dry way*, the old chemists designated an opinion by which they were able, by a long continued cementation, to remove, almost entirely, silver, and the other metals that are found alloyed with gold. This process has its origin in the highest antiquity, and it was not till near the year 1350, that the method of parting by aquafortis began to be at all known throughout Europe; while, owing to the high price of the acids, the use of this process was, for a long time, confined to the laboratories of experimenters, and the operations by the dry way, such as sulphuration by crude antimony, (sulphuret of antimony,) treatment with corrosive sublimate, and cementation with white clay and salt, continued to be employed for the purification of gold.

Since that time, however, among the various results effected by the great progress of the arts dependent upon chemistry, the great diminution in the price of the acids, that followed as a consequence, soon rendered the method of parting in the wet way practicable on a large scale; and it is generally known to what a high degree of perfection the refining of gold and silver is now carried, by the French in particular, so that, at the present day, the ancient processes have been entirely abandoned throughout Europe.

But the European arts, which were established in the new world at the period of its discovery, have remained there so nearly stationary, that I found, not long since, in various workshops, the processes of the middle age. Thus, in establishments as important as the mints of New-Granada, the separation of the silver contained in the gold of the mines, is still effected in the dry way. I could hardly have been placed in circumstances of a more interesting nature than thus to find myself, as I did, among the instruments of the period of the chemistry of the furnace, and even to meet, scientifically speaking, with the men of that epoch. It was as if I had met with chemists, who had just waked up, after a sleep of three centuries.

In the mint of Santa-Fe, cementation, or parting in the dry way, is always employed, when it is desired to free the gold of the mines from the silver that is combined with it, oftentimes in large proportions, so as to bring it to the state of purity required by the law for the regulation of the gold coinage.

The argentiferous gold being first reduced to the granular state, is subjected to the process of cementation in kettles of porous earth. The cement is composed of two parts of brickdust, and one of powdered sea salt, mixed together. A layer of this cement is first spread out on the bottom of the vessel, and is then covered with the granulated ore; this last is then covered with a fresh layer of cement, and so on. The layers of cement should be

* At the request of the Committee on Publications.

about an inch in thickness. A cementing pot contains, generally, from ten to fifteen pounds (French) of gold.

The furnace in which the cementation is effected, is a hollow cylinder, four and a half feet in height; at about three feet from the ground, is placed a grate, on which the cementing pots stand. At the bottom of the furnace, on the very level of the ground, an opening is made, through which the fuel is introduced. This furnace has neither fire grate nor chimney, and the cementing pots are put in and taken out from above.

The operation requires from twenty-four to thirty-six hours, varying with the quantity of silver to be extracted; the cementing pots are kept at a cherry red heat.

The operation being finished, the cement is washed in water, which causes the gold to separate in grains, of about twenty-one to twenty-two carats. These are melted together into bars of a suitable size, for *lamination.*

The cement, after being pounded into a fine paste, is mixed with one-tenth its weight of sea salt, and then amalgamated with mercury. The mercury added is nearly ten times the amount of silver present in the cement. The process of amalgamation is carried on in large wooden troughs, at a temperature varying from 14° to 18° of the Centigrade scale, (57.2° to 64.4° Fahrenheit,) the operation requires from four to five days.

The chloride of silver enclosed in the cement is reduced by the mercury, during the process of amalgamation; chloride of mercury is formed, and carried off in the washings; while the metallic silver amalgamates with mercury. This amalgam is always very dry, on account of the large quantity of chloride of mercury diffused through its mass. The silver obtained after driving off the mercury, is nearly pure, containing only a few thousandths of gold. In the process of cementation, the silver is converted into a chloride by the action of the dry clay, and the equally dry marine salt, a reaction which does not receive a satisfactory rationale from the facts hitherto determined on the subject.

But, however this may be, since the process was attended with success, in the case of argentiferous gold in large sized grains, I determined to apply it to the extraction of silver contained in powedred gold, extracted by washing from pyrites. This gold ordinarily contains 0.26 of silver; but before operating on large quantities, I wished to attempt certain modifications, by erecting a furnace more economical in point of fact, but particularly by the substitution of Cornwall crucibles, for holding the mixed powders, instead of the fragile vessels above referred to, so that the chances of fracture might be diminished as far as possible. With this view, the mixture of powdered gold and cement was placed in a crucible, and exposed for thirty hours to the heat of a furnace, wood charcoal being used for fuel. At the end of this time, the standard of the gold was not sensibly altered; a result which, it will be admitted, was calculated to surprise. I had the patience to keep the powdered gold under the heat for seventy-two hours; but, notwithstanding, the gold was found, after the operation, to contain almost as much silver as before it was subjected to the fire. In a word, all my efforts with good crucibles uniformly failed, and I was forced, to the great satisfaction of the workmen, to return to the *ancient* method of operation. It seemed extremely probable that the access of air was indispensably necessary to ensure the success of the cementation; it was, at least, only in this way that I could account for the advantage presented by badly burnt and porous earthen vessels, over crucibles of a good quality, and, so to speak, impermeable. To satisfy myself on this point, I made the following experiment.

I took two laminæ of silver, weighing each 24.6 grains; one of these I placed in the centre of a small porcelain vessel, filled with a cement of sea-salt and brickdust; the vessel was placed in the centre of a crucible, and covered over with charcoal powder, heaped up around it; so that all precautions were taken to keep the metal out of contact with the air. The other silver plate was, on the contrary, exposed on a cupel containing the cement, and the cupel was placed under the muffle of an assay furnace; so that, in this case, the access of air was facilitated as much as possible. Heat was applied for seven hours; the sheet enclosed in the crucible had not, at the end of that time, materially diminished in weight; it still weighed 24.3 grains; while, on the contrary, that placed under the muffle weighed only 9.5 grains; it had, consequently, lost 15.1 grains. The surface of the second plate was much corroded, and the cement was impregnated with chloride of silver.

The presence of air was thus, shown to be indispensable to the success of the cementation; but its action, in the conversion of the silver into a chloride, still remained to be examined. I first endeavored to determine whether sea-salt alone could attack silver at a red heat; but a sheet of this metal, placed in a cupel, under the muffle, and covered over with sea-salt, experienced no alteration, ever after being subjected for three hours to the heat. During the pro-

gress of this experiment, I had occasion to observe the great increase in the volatility of chloride of sodium, produced by the passage of a current of very hot air. The salt, as soon as it was placed in the cupel, (under the muffle,) gave out fumes in abundance, and, in a short time, was entirely dissipated.

It follows, then, from this experiment, that the presence of the clay, also, is essential to the conversion of the silver into a chloride, by the action of sea-salt; and as it is composed of silica and alumina, it appeared worth while to study separately the action of these two substances.

Two laminæ of silver, weighing each 6.5 grains, were accordingly placed in two different cupels; in one of these cupels was put a cement, composed of silica and sea-salt; in the other, a cement composed of alumina, and the same. For four hours, the muffle of the furnace was kept at a heat above cherry red; at the end of this time, the silver in the aluminous mixture had completely disappeared. On cooling, the cement belonging to this cupel was slightly agglutinated; it presented a crystalline structure, but was not sensibly saline to the taste. When first taken from the furnace, it was of a brilliant white appearance, but on exposure to the solar rays, it soon acquired a deep violet tint; the sheet enclosed in the silicious cement still weighed four grains; it presented a very striking crystalline appearance, over the whole extent of its surface; certain points were covered with plaster, so to speak, of an olive green, which adhered strongly to the metal; the parts of the cement that had been in contact with the silver, were of deep brown color. The cement was not saline to the taste, and was almost wholly vitrified. It is doubtless to this last circumstance that the failure of the cementation with the silicious mixture must be attributed.

It is known that, even at a high temperature, silica exerts positively no action upon sea-salt, if the materials be perfectly dry; but the researches of MM. Thenard and Gay Lussac, have shown that the presence of watery vapor immediately determines an energetic action, attached by the disengagement of hydro-chloric acid gas, and the formation of silicate of soda. It is evident, then, that, in the above experiment with the silicious cement, vapor of water was present, since the chloride of sodium was vitrified by the silica. The air, in traversing the muffle of the cupel furnace, must, then, have carried with it a sufficient quantity of watery vapor to establish the reaction. In cementing on a large scale, such as is carried on at Santa-Fe, the cementing materials are constantly surrounded with watery vapors, produced during the combustion of the wood.

To prove that it is really the vapor of water constantly present in the atmosphere, or that produced during the combustion of the fuel, which renders the presence of air necessary in the cementing process, I placed a sheet of silver, surrounded with cement, in a porcelain tube, and, after raising it to a red heat, caused a stream of well dried air to pass through it; as I expected, the silver suffered no change whatever. A difficulty, however, still remained. If, as seemed evident, the vapor of water be the agent that determines the action of the earths on the sea-salt, hydro-chloric acid should, indubitably, be produced; and as we have found that the silver is transformed into a chloride, and no hydro-chloric acid is evolved, it follows, as a probable consequence, that the last named substance is decomposed by silver at a red heat, though this metal is generally supposed to exert no action whatever on hydro-chloric acid gas, even at high degrees of heat: this point remained, them, to be determined. A lamina of silver, twisted into a spiral, was introduced into a tube of porcelain, and placed in a furnace. By one end of the tube was introduced a current of hydro-chloric acid gas, previously dried by passing through chloride of calcium;* at the other extremity was fitted a tube, entering under a bell glass filled with water. When the heat rose to a red, hydrogen gas began to be disengaged, but very quickly ceased coming over, the acid gas then continuing its passage, without decomposition, and the water of the bell glass became acid. On examination, the surface of the silver was found to be covered with a varnish of chloride of silver, and it was clear that the metal had been protected from further contact with the acid by the coating thus afforded it.

* In my first experiments, I did not adopt the precaution of drying the acid; but in consequence of a suggestion that the effects might be possibly due to the decomposition of water, the affinities called into play being those of silver for oxygen, and of hydro-chloric acid for the oxide of silver, in which case, the hydrogen evolved would be furnished by the water, I caused the gas, in my succeeding experiments, to pass previously over chloride of calcium. An objection might, however, still be raised; it might possibly be the case, that the gas was not completely dessicated by the chloride, but that a portion of aqueous vapor still remained. To determine whether this be the case, I made use of a test previously employed by M M. Thenard and Gay Lussac. I caused a portion of the dried gas to pass into a receiver of fluoboric acid gas, but the mixed gases retained the transparency they possessed when separate. The extreme sensibility of the fluoboric acid gas, as a hygroscopic agent, was shown by the admission of atmospheric air into the mixture, when a cloud was instantly produced.

To remedy this difficulty, in a measure, the silver lamina was surrounded with alumine, for the purpose of absorbing, as much as possible, the chloride produced. This second experiment succeeded much better than the former, and I was enabled to fill several test tubes with the hydrogen evolved; the exit of this gas under the receiver took place, however, in very small bubbles, and it was easy to perceive, from the strong acidity of the water, that the greater part of the acid still escaped decomposition. The evolution of hydrogen became slower and slower, and soon entirely ceased. The silver, when examined, was found to be much corroded, although the chloride produced had entered but very little into the body of the alumine, and the metal was still covered with a layer of chloride, which was a sufficient reason why the silver had escaped final destruction.

In a second experiment, in which I added sea-salt to the alumine, the operation continued without interruption, although, as in the preceding experiments, the hydrogen was evolved in very small bubbles, and the greater part of the acid passed over without decomposition. The addition, in this case, of the sea-salt, was found to have greatly facilitated the diffusion of the chloride of silver through the alumine, and it is more than probable that the effect is due to the tendency of the two chlorides to combine together. The double chloride thus produced may be formed directly by the addition of chloride of silver to chloride of sodium, in a state of fusion. When thus formed, it solidifies, on cooling, to a low red heat, and, when cold, is vitreous, transparent, and slightly opaline; its taste is saline, and not at all metallic; it is decomposed by the contact of water. Exposed to the solar light, its color changes to a violet.

I further demonstrated the action of hydro-chloric acid on silver, as follows:

A very thin lamina of this metal, weighing 13.3 grains, was put into a cupel, and a current of the acid gas was caused to flow, for an hour's time, under the muffle of the furnace in which it was placed. During the whole of the experiment, a light white vapor arose from the cupel. The silver, after the operation, was found to weigh only 9.5 grains; its surface was corroded; no trace of chloride was observable on the cupel; in this case, the chloride was evidently carried off, at the instant of its formation, by the gaseous stream. It might be supposed, from the power possessed by silver of fixing oxygen at high temperatures, that, during the cementing process, the contact of the air facilitated the action of the acid by furnishing that gas; but a comparative experiment, made with two silver laminæ, presenting exactly the same extent of surface, showed that this is not the case, and that the oxygen of the air does not sensibly facilitate the action of hydro-chloric acid on silver.

The decomposition of hydro-chloric acid by silver, is an analogous fact with that of the decomposition of water by iron. The silver absorbs the chlorine of the acid gas, in like manner as the iron does the oxygen of the watery vapor, and hydrogen is set at liberty in both cases. On the other hand, at the same temperature at which these decompositions are produced, hydrogen gas possesses the property of reducing to the metallic state, the chloride of silver, and the oxide of iron, with the production, respectively, of hydro-chloric acid and water.

When silver is submitted to a continuous current of hydro-chloric acid gas, the hydrogen evolved is immediately enveloped in so large a quantity of the acid gas, that the mixture is too dilute—the hydrogen being considered the active agent—to react on the chloride already formed; the hydrogen, moreover, is rapidly carried off by the gaseous current.

When, on the other hand, chloride of silver is reduced by a current of hydrogen, the inverse is the case; the hydro-chloric acid produced is rendered inactive, by reason of the large amount of free hydrogen present.

To convert silver into a chloride by the action of hydro-chloric acid gas, it will then be necessary to employ a great excess of the latter; and, on the other hand, to reduce the chloride of silver, a much greater amount of hydrogen will be required than is simply sufficient to convert the chlorine into hydro-chloric acid.

The fact of the decomposition of hydro-chloric acid by silver once admitted, the phenomena that ensure during the process of *parting in the dry way*, are readily explained; the clay of the cement, assisted by the presence of watery vapor, reacts on the sea-salt; hydro-chloric acid results, and converts the silver into a chloride. The chloride thus produced combines, probably, with the sea-salt, and forms with it a double chloride, which is absorbed by the mass of the cement, so as to leave the surface of the silver perfectly clean. A fresh portion of the hydro-chloric acid is thus permitted to act on a fresh surface of the silver, and the operation is thus enabled to continue until the latter has been entirely converted into chloride.—[Annales de Chem. et de Phys.]

MODE OF JOINING TWO PIECES OF AMBER.

Two pieces of amber may be very readily united by the following means.

Wet the surfaces that are to be united with a solusion of caustic potash; heat them, and then press them together; the two pieces will unite so perfectly, that no trace of any joint can be perceived. Thus, with small pieces of amber, compact masses may be easily formed, which is an advantage in the arts.—[Journal Franklin Institute.]

NEW METALLIC CEMENT.—A new metallic cement, for which a patent has been taken out, consists of powdered scoria from the copper works, mixed with stone and lime. It sets rapidly, and takes a fine metallic polish. It is now being used by Messrs. Harrison, in a large building intended for an inn, at the south-west corner of London Bridge. This cement, unlike all other kinds except Frost's, is sold mixed up ready for use. The price is 9*d.* per bushel. If the scoria, in a state of powder, were sold by itself compressed in casks, it appears to us that it would form a very desirable cement for exportation. It may be laid on in coats as thin as the fourth of an inch, but it has not been a sufficiently long time in use to determine to what extent it will crack.—[Lon. Mec. Mag.

[From the London Mechanics' Magazine.]

TILLEY'S NEW METALLIC FIRE ENGINE.

Sir,—After witnessing the introduction of boats, bridges, and churches, of cast iron, with many other extraordinary applications of this highly useful material, your readers will not be much surprised at the introduction of cast iron fire engines, and this material enters pretty largely into the machine I am about to describe.

It is well known that hot climates exercise a most injurious effect upon all things constructed of wood, especially if occasional moisture assists the operation of the heat. Among other machines which manifest the existence of this destructive influence, fire engines are particularly liable to dilapidation; sometimes saturated with water, and then exposed to parching dryness—laid by unheeded until required for use—no wonder they are so often found unserviceable. To obviate the serious inconvenience arising from this cause, and to render the fire engine, as far as possible, proof against the effects of climate, Mr. W. J. Tilley, engine maker, Blackfriars road, London, has constructed a fire engine entirely of metal, of which fig. 1 is a side, and fig. 2 an end view. The same letters of reference apply to both drawings. (For the drawings see the two following pages.)

a a a are three cast iron standards, fixed upon a quadrangular floor or frame-work *b b*, of the same material. *c c* is the main axis working in brass bushes on the tops of *a a*. *d d* are the two brass cylinders or pumps. *e* is the air vessel, of copper; *f* is the suction pipe; and *g* the delivery pipe. A chamber *h* contains the suction valves, the delivery valves being placed in a similar chamber *i* in front of the cylinders. *k k* are the handles, made of sheet iron rolled up, which, by means of the cross levers, impart alternate motions to the pistons.

The pistons are attached by slings to a projecting arm on the axis *c*, the parallelism of the pistons being preserved by guide rods in the usual manner. *l* is the fore carriage.

The whole is mounted on four cast iron wheels, and has rather a light and elegant appearance.

In the construction of this engine not a particle of wood is employed; the valves, the pistons, and, in fact, every part is of metal.

This engine exhibits, in a very pleasing manner, the situation of all the working parts, which, in fire engines of the ordinary kind, are enclosed from view; but a most important advantage consists in the facility with which any little derangement in the machine can be seen and remedied. The valves, which are almost the only parts liable to get out of order, can be got at immediately, as it is only necessary to unscrew and remove the cover of the valve chambers, to examine and repair any obstruction in this part of the machine.

The durability of this description of fire engine, and its fitness for all foreign stations, especially in hot climates, must be so great, that for such services I have no doubt they will in time supersede all other engines constructed of so perishable and uncertain a material as wood.

I remain, Sir, yours respectfully,

London, June 24, 1835. WM. BADDELEY.

TILLEY'S NEW METALLIC FIRE ENGINE.

Fig. 1.

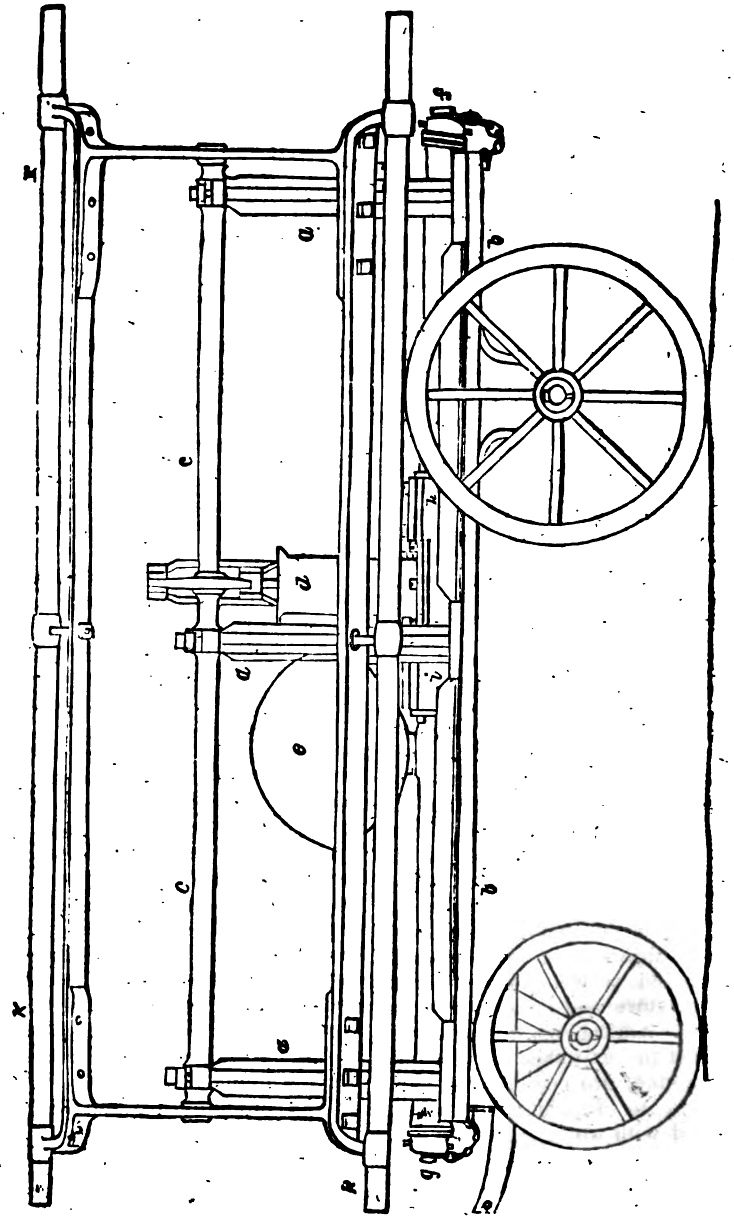
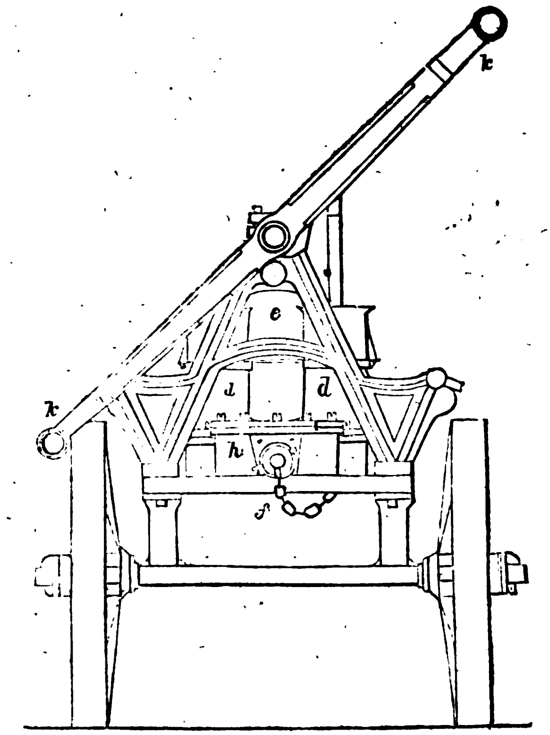


Fig. 2.



[From the London Mechanics' Magazine.]

Portland Breakwater.—Sir,—I regret that my official duties have prevented my paying earlier attention to Mr. Lamb's communication, dated 4th March, No. 605; not that I think it a matter of any consequence, as affecting my late father's claim to priority of design for the Portland Breakwater, but lest my silence should be construed as a tacit admission of Mr. Lamb's claims. I take it for granted, that if any communication on a breakwater for Portland roads shall appear to have been made by my father previous to June, 1812, (the earliest period to which Mr. Lamb can carry back his suggestion,) then the originality will rest with my father. Now Mr. Ham, with whom I have had no intercourse, directly or indirectly, for more than twenty years, until within the last fortnight, having seen the correspondence in the Mechanics' Magazine, unsolicitedly wrote a letter, (published in Mech. Mag. p. 269, vol. xxii.) in which he says, "I can add my testimony, that in the year 1800 I frequently heard him (meaning my father) speak of his plan, and give minute details of the same;" and in a subsequent letter which I have received from him, dated 24th May, 1835, he adds—"I can still recollect that he (meaning my father) appeared quite *au fait* in all the details, and delighted to explain them to the nobility and gentry, who so frequently visited his library, when George III. drew such a concourse of them to Weymouth. This allusion, you will perceive, will carry the date of your father's plan even prior to the year 1800. I soon after left Weymouth."

I can mention many other persons who were well acquainted with my father's designs, and to whom he made occasional written as well as verbal communications, in reference to the subject anterior to 1812. A communication was made to Lord A. Beauclerk, in June, 1810. Gen. Donmourier, an engineer of no common order, had also frequent interviews and

conversations with my father on this subject, as being intimately connected with the improvements of our maritime competitors at Cherbourg, then in progress; from him my father received many important hints in futherance of his own ideas. A communication was made to Lord Sidmouth in September, 1810, on the same subject. I have numerous letters to my father from gentlemen who were in the habit of frequenting Weymouth at the time of the visit of his late Majesty, George III., in which reference is constantly made to him as the person who had first suggested the idea of a breakwater at Portland. My father communicated his design to Mr. Idle, confidentially, in June, 1812, when that gentleman was a candidate to represent Weymouth. At that period the subject was generally discussed, and no doubt, from the publicity given to it, Mr. Lamb's intentions originated, as his professional connexion with Mr. Idle afforded him the opportunity of being well acquainted with every transaction, private as well as public, in which Mr. Idle had any share. The slight intercourse which then took place between my father and Mr. Lamb, was not of such a description as to require or induce him to make a confidential communication. The question of originality was never mooted, because there could be no doubt upon the subject. In all my father's extensive correspondence with men of rank and influence, there is but one opinion expressed, namely, that the design first emanated from him. As to my father's silence, on which Mr. Lamb seems to lay so much stress, that merely shows that he was cautious of committing himself to strangers, and that he had not taken any steps to carry his design into execution, because he did not possess pecuniary means sufficient to justify his embarking in so extensive an enterprise. If Mr. Bracebridge *had not known* that my father had possessed plans and particulars before August, 1813, what could have induced him to apply for them? He says, under date August 13th, 1813, "Though dismissed, perhaps, for want of encouragement, from your present intention (pending a more favorable period for such an enterprise,) I am confident a mind capable of forming such a design, could never willingly abandon it. As I understand you had in your possession, plans, soundings, and various requisite materials for this great work, upon which such has been my reflection and contemplation, and consequent admiration of the plan, that I have ventured to mention it to some confidential, scientific, and, otherwise, able friends," &c. &c. Again—"These, sir, were the feelings which led me to wish it may be in my power to render you any service in this matter, and induce you to turn your mind again to a plan on which you have already bestowed so much trouble and attention." Can this be any thing but conclusive? Is there any symptom of a competitor for the credit of origination? Must it not have been known to Mr. Bracebridge, if Mr. Lamb had hinted any intention of claiming the projection of a breakwater at Portland, and would Mr. Bracebridge have thus written with such a knowledge? Mr. Lamb does not put forth his claim until the year 1834, when Mr. John Harvey, the original projector of this design, is dead. If Mr. Lamb had any pretence to originality in this matter, how happens it that even Mr. Idle, so late as 1818, wrote a letter to my father on the subject, addressing him as being not merely a principal, but the only projector of the undertaking? Indeed that gentleman, as well as Mr. Bracebridge, always considered my father as the *individual* with whom the design for a breakwater at Portland had originated. And so did, I may truly say, the entire population of Weymouth and its neighborhood, since no farther back than July last, 687 of the principal inhabitants signed a petition to his present Majesty in favor of a breakwater based on my father's plan, *in which he was distinctly recognised as the father of the projected undertaking.*

I am, Sir,

Your very obedient servant,

JOHN HARVEY.

Weymouth, June 6th, 1834.

[From the London Mechanics' Magazine.]

THE TELEPHONY, OR MUSICAL TELEGRAPH.—In January 1828, a M. Sudre presented to the French Academy of Fine Arts the scheme of an universal language, formed of the seven musical signs, *re, mi, fa, sol, la, si, do,* variously combined, to which he, therefore, gave the name of

"The Musical Language." A Committee of the Academy, including three of the most distinguished philosophers of the age, MM. de Prony, Arago, and Fourier, reported, that after "causing several experiments to be made and repeated in their presence," they had "come to the conclusion, that the author had perfectly attained the end he had in view, namely, that of creating a *real musical language*;" and that a system of telegraphic communication might be established by means of this language, and the aid of musical instruments, far superior to any hitherto in use, inasmuch as it would enable men to correspond instantaneously with each other at great distances, not only during the most profound darkness, but under circumstances in which even in open day, no communication by visible signals could possibly be carried on.

The invention was afterwards referred by the Minister of War to a Military Commission, of which Baron Despres was President, which made an equally favorable Report upon it. After stating that, in their opinion, "the 'Musical Language' might prove eminently useful in establishing a correspondence between the different corps of an army," they give several remarkable instances in which it might have been the means of saving the French arms from discomfiture; as at the battle of Busaco, when the attack made by the French troops failed "in consequence of a division, whose march was arrested by a deep chasm, being unable to give immediate information of the circumstance to the other divisions from which it was separated by the abrupt winding of the mountains;" or the affair of Forroren, in 1813, when "the difficulty of communicating promptly and directly in a mountainous country" was the cause of the French army failing in its attempt to raise the siege of Pampeluna.

M. Sudre's invention was next investigated by a Commission of Naval Officers, who reported it to be their unanimous opinion, that "it would be a powerful auxiliary to the means at present used in the navy, and ought to be immediately adopted." From a series of experiments made by this Commission in the bay of Toulon, it appeared that "it only required two minutes to transmit by means of the 'Musical Language,' from one point to another, distant 9,000 feet, three orders taken from the book of signals."

The system was finally submitted to a Committee of all the five Academies of the French Institute—being now in a much more perfect state than when it was first laid by M. Sudre before the Academy of Fine Arts—and from the Report of this Committee, (which was adopted by the Institute,) the following are extracts:

"The Committee are of opinion, that the 'Musical Language' invented by M. Sudre—

"1st. Furnishes a means of communication capable of expressing all our ideas.

"2d. Either by sounds or by (written) characters.

"3d. At short or long distances.

"4th. Openly or secretly (that is, by using combinations of the signs, known only to the corresponding parties).

"And, 5th. That this system of sounds is not liable, like spoken languages, to change with time, but is essentially unalterable."

* * * *

"The Telegraph can only be used at certain stations, upon heights, when every thing has been foreseen, tried, regulated before hand and at leisure. It is impossible to make use of it without preparation, and it is perfectly unavailable under a variety of circumstances of time and situation.

"But the Telephony can be put in practice on land in almost every place, by day or by night, without any change in the method, and even more easily by night, on account of the profound silence which then pervades the earth.

"This generality of application acquires additional value, when it is considered that the instrument is of the most portable description; that it is always *at hand in those very circumstances when the greatest benefits would be derived from its use*; and that the persons who make use of it for other purposes would speedily learn to apply it to the one before us; all these conditions are of the highest importance for all practical applications."

The particular "instrument referred to in the last extract is the French horn or trumpet, which may be heard at a distance of three miles, and is that which

would most probably be employed in all cases of distant communication; but of course any instrument capable of expressing the different musical signs may be made the organ of this new language.

M. Sudre is now in London for the purpose of unfolding all the details of his system to the English public; for it would seem that, notwithstanding the various strong reports which we have cited in his favor, he has met with but poor encouragement from the government of his own country. Let us hope that better fortune awaits him amongst us. His system displays in its general conception great ingenuity, and appears to us capable of being rendered very extensively useful.

Extracts from a Lecture on the Preservation of Timber by Kyan's Patent for preventing Dry Rot: delivered by Dr. Birkbeck, *at the Society of Arts, Adelphi, December* 9, 1834.

We have heard persons assert that it appears to them almost ridiculous to suppose that it ever can become necessary, on a large scale, to perform any operation with a view to render timber durable, beyond that of properly seasoning it by exposure to the atmosphere. But is not this mere prejudice? Why should not timber be prepared by a particular process, which conveys something additional into it, and thereby effects a chemical change in its nature, as well as leather is tanned?

"A very effectual procedure has taken place, in regard to one form of animal matter, by the preservation of the skin from natural decay in a process known by the name of 'Tanning.' This process will give a very good idea of Mr. Kyan's invention. Tanning oonsists in protecting the leather and skin by the introduction of tannin, which is generally derived from an infusion or decoction of the bark of the oak. If no change were produced in the gelating, which makes the largest part of the skin to be immersed in the tan pit, it would undergo certain chemical changes—it would putrify, and lose its tenacity; but if a portion of animal jelly is dissolved in water, and a little of the substance added, similar to the tannin, a combination will take place between the gelatine; a precipitate will follow of the animal matter, which is the tanno-gelatine, or a compound of tannin and gelatine, and is precisely that substance which is formed in the leather, and gives to it durability and power to resist the causes of decay. The same intention exists in the process of Mr. Kyan. It is true he does not act on the gelatine of animal matter, but he does on the albumen: one of the approximate principles of vegetable matter, which appears to have been slightly perceived by Fourcroy, but which was actually discovered by Berzelius, about the year 1813.

"In order to obtain this vegetable matter (*albumen*,) there are various substances which may be employed. The Hibiscus esculentus yields it in considerable abundance: it is a West Indian plant, which Dr. Clarke mentions as adopted in Demerara, for the same purpose, as, in other Islands, the white of eggs and blood are employed in the process of clarifying sugar. The ficus indica, also, if divided at the stem, will exude a considerable quantity of this matter. If the solution of the bichloride of mercury (which is the agent adopted by Mr. Kyan) is added to the vegetable matter, albumen, it will be found, when they come in contact, that decomposition occurs."

"Mr. Kyan, who had been a series of years (since 1812) engaged in *trying* a variety of experiments on the preservation of timber, was led to the present experiment by having, as he conceived, at length ascertained that *albumen* was the primary cause of putrefactive fermentation, and subsequently of the decomposition of vegetable matter. Aware of the established affinity of corrosive sublimate for this material, he applied that substance to solutions of vegetable matter, both acetous and saccharine, on which he was then operating, and in which albumen was a constituent, with a view to preserve them in a quiescent and incorruptible state, and obtaining a confirmation of his opinions by the fact that, during a period of three years, the acetous solution openly exposed to atmospheric air had not become putrid, nor had the saccharine decoction yielded to the vineous or acetous stages of fermentation, but were in a high state of preservation; he concluded that corrosive sublimate, by combination with

albumen, was a protection against the natural changes of vegetable matter."

"The mode in which the application of the solution takes place, is in a tank similar to the model on the table. They are constructed of different dimensions, from 20 to 80 feet in length, 6 to 10 in breadth, and 3 to 8 in depth. The timber to be prepared is placed in the tank, and secured by a cross beam to prevent its rising to the surface. The wood being thus secured, the solution is then admitted from the cistern above, and for a time all remains perfectly still. In the course of 10 or 12 hours the water is thrown into great agitation by the effervescence, occasioned by the expulsion of the air fixed in the wood, by the force with which the fluid is drawn in by chemical affinity, and by the escape of that portion of the chlorine or muriatic acid gas which is disengaged during the process. In the course of 12 hours this commotion ceases, and in the space of 7 to 14 days (varying according to the diameter of the wood) the change is complete, so that as the corrosive sublimate is not an expensive article, the albumen may be converted into an indecomposable substance at a very moderate rate."

After stating the result of various experiments, Dr. Birkbeck concludes by observing that this discovery is yet in embryo, but that the public benefit that will result from it is beyond calculation. In an *Appendix* the various purposes to which the process is applicable are detailed: such as preventing dry rot, seasoning timber, protecting from insects, applying the process to Canada and British timber, and preserving canvass, cordage, &c. from mildew.

"Canada timber is much more liable to decay than that grown in the northern parts of Europe, and for this reason is never used in buildings of a superior description. The principle of decay being destroyed, as above shown, this objection is no longer in existence; and this kind of timber may now be employed with as great security as that of a superior quality and higher price.

"The same observation applies with great force to timber of British growth, particularly to that of Scotland, much of which is at present considered of very little, if any value for durable purposes, on account of its extreme liability to decay, whether in exposed situations or otherwise. The present process will, therefore, render of considerable value, plantations of larch, firs of all kinds, birch, beech, elm, ash, poplar, &c., which are the chief products of the great wooded estates, and which, when prepared, may be advantageously employed to most useful purposes."

"*Purposes for which the Prepared Timber, &c., would be highly useful.*—Houses, farm houses, out houses. Large timbers, floors, roofs, gutters, &c., furniture, and all joiner's work, preserved from dry rot, and perfectly seasoned. Posts, rails, gates, park paling, fences, hop poles, felloes, spokes, shafts, &c. &c. For these purposes any kind of timber may now be used, instead of the more expensive kinds. It will also supersede, in many cases, the employment of iron, from its acquired durability and greater economy."

The additional expense of preparing timber for buildings, such as farm houses, out houses, &c. in Mr. Kyan's manner is estimated at the very moderate sum of 20*s*. per load.—[Arch. Mag.]

[From the United Service Mil. and Nav. Mag.]

PATENT BRONZE SHEATHING.—There has been delivered this week to his Majesty's Dock Yard here, a quantity of the *Patent Bronze Sheathing*, and directions have been given by the Lords of the Admiralty to sheathe two of the Falmouth packets that may next require coppering, one side with the patent bronze, and the other with copper, so that a comparison may be fairly established of the duration of the two substances.

We have been favored with an inspection of a sheet of the bronze, and certainly it is a most beautiful specimen of manufacture. But notwithstanding its density and polished surface, it is at the same time quite malleable and pliant.

The subject, we are aware, is one of great interest, and we have, therefore, collected the following details relative to this new invention, which, we understand, originated with a French engineer, and was first tried in the French navy in 1829; since which, on account of its superior durability, ascertained by repeated experiments, the French government has

contracted for several hundred tons a year. In every instance it has been found to keep quite *clean*, a point of paramount importance, whilst from its superior hardness, it is not so liable to be rubbed in case of a vessel taking the ground or running foul.

The durability of ancient bronze coins, medals, and utensils, has long excited attention; numerous specimens are found in Egypt, Greece, and Italy. The famous horses of St. Mark, at Venice, are a remarkable instance of preservation; but it was never thought practicable to render such a hard and dense metal malleable so as to convert it into sheets. The beautiful specimen we have seen, proves that this difficulty has been at last overcome.

We are informed that the usual composition of the bronze of antiquity, was copper combined with six to ten per cent. of tin. Bronze is in fact copper hardened, and rendered less liable to oxidation, by the addition of tin.

The wear of copper on ships' bottoms is a mechanico chemical action, inasmuch as its waste at sea is six and a half times greater than in harbor. We should conclude, therefore, *a priori*, that a hard metal, like bronze, would waste less by the friction of the water, than a soft metal, like copper; and the greater duration of ancient bronze, proves that it is less oxidable. There would thus be established a superiority in resisting mechanical as well as chemical action in favor of the bronze. The result of the experiments made in the French navy on bronze sheathing, *very imperfectly manufactured*, as stated in the "Aunales Maritimes" for 1830, '31, and '32, goes to prove that when applied to ships' bottoms, the loss in weight of the bronze is less than half that of copper.

It appears now established, that a continued and necessary wasting of the metallic sheets alone secures a clean bottom, and that no galvanic protection is compatible with it, fresh surfaces of the metallic sheets must constantly be presented by the washing away of the scale or oxide; every thing that attaches to the bottom in calms or in harbor, whether seeds of marine plants, or spawn of animalculae, is thus undermined and carried off, leaving the sheathing bright and clean. With the bronze, as with copper, the same continuous wasting is going on, but *with one half of the loss in weight*, owing to its greater hardness and density, and its inferior oxidability. Lead, zinc, etc. foul on ships' bottoms, not because their oxides are less poisonous than that of copper, but because, instead of being washed off, their oxides are adhesive, and eat, (if we may so express ourselves,) into the sheets, thus allowing whatever fastens on the bottom to remain there and increase. Sir H. Davy's protected copper failed for the same reason—there was no oxide formed, the copper did not waste at all, and thus became foul.

There is, however, one obstacle, to the general use of bronze, which those who like cheap articles will hardly get over, namely, it is 2*d* per lb. dearer than copper, which the English patentees, Messrs. Vivian & Sons, state that they are obliged to charge to cover the great extra expense of rolling so hard and dense a metal into sheets, and the patent right; but we apprehend, if on trial the bronze, instead of giving double the wear of copper, gives only one half more, or as four years and a half to three years, this additional first cost will be trebly repaid to the ship owner, as nothing is so vexatious and expensive as putting a ship into dock to get her re-coppered, when she does not require other extensive repairs. On whaling, and other distant foreign voyages, the longer duration of sheathing is a great desideratum. Even the first outlay may be eventually reduced by the use of bronze sheets eighteen or twenty ounces to the foot, instead of copper sheets of twenty-eight or thirty ounces per square foot.

Nearly the whole of the whaling and India ships from Havre are sheathed with bronze, and several have returned from these long voyages with their bottoms perfectly clean, and the sheathing very little worn. It is now extensively in trial on ships from London, Liverpool, Greenock, etc., so that the results obtained in France will soon be severely tested in this country.

We find we have omitted to notice a point of great importance in the sheathing for ships' bottoms, which is, that the wear should be uniform over the whole surface of the sheets. It is well known that copper sheathing is greatly subject to be cor-

roded into holes, and this especially happens when a vessel has been for some time in ordinary at her moorings, so that the sheathing often becomes unserviceable from this cause, although its total loss in weight is very small. This occurred in two instances in the trials made by the French navy, where one side was covered with copper and the other with bronze. Although the vessels had not been out of harbor, they were obliged to take off a considerable part of the copper, whilst the bronze sheathing was quite perfect, having worn uniformly over the whole surface.

Balloon Communication between London and Paris.—We perceive that the grand aerial project which occupied so much of the attention of the Parisian quidnuncs about this time last year, is revived—with this difference only, that the scene of operation, or to speak more properly, perhaps, the starting-post, has been shifted from Paris to London. The projectors who have now taken unto themselves the style and title of the "European Aeronautical Society," announce in the newspapers that their "first aerial ship, the Eagle, 160 feet long, 50 feet high, and 40 feet wide," and which is to be (?) "manned by a crew of seventeen persons," may be inspected at a certain *dock* in the neighborhood of Kensington, previous to making its first trip "from London to Paris and back again;" after which it is to make similar trips to Brussels, Amsterdam, Berlin, Munich, Madrid, &c., till the practicability of establishing an aerial communication between London and the other capitals of Europe, is fully and incontrovertibly demonstrated! The scheme is, after all, only a copy, and that but an indifferent one, of a plan that was proposed as far back as 1796, by an engineer of the name of Campenas, and not only entertained by the French government, but sanctioned by that select body of *savans*, the French Institute. Campenas wrote a long letter to Bonaparte, then General-in-Chief of the army of Italy, from which we extract a paragraph or two. "*General Citizen*,—The artist who addresses you, filled with the most lively gratitude, will erect, if the means of execution be afforded him, a vast edifice, whence, at the conclusion of his labors, there will issue an Aerial Vessel capable of carrying up with you more than 200 persons, and which may be directed to any point of the compass. I myself will be your pilot. You can thus, without any danger, hover above the fleets of enemies jealous of our happiness, and thunder against them like a new Jupiter, merely by throwing perpendicularly downwards firebrands made of a substance which will kindle only by the contact and percussion at the end of its fall, but which it will be impossible to extinguish. Or perhaps you may think it more prudent to begin at once, by forcing the British cabinet to capitulate, which you may easily do, as you will have it in your power to set fire to the city of London, or to any of the maritime towns of England. From the calculations I have made, I am convinced that with this machine you may go from Paris to London, and return back again to Paris in twenty-four hours, without descending. The object I propose is to establish in the great ocean of the atmosphere a general navigation, infinitely more certain and more advantageous than maritime navigation, which has ever disturbed the tranquillity of mankind—to restore the perfect liberty of commerce, and to give peace and happiness to all the nations of the universe, and unite them as one family. By great labor I have surmounted the multiplied obstacles which presented themselves before me; and my progressive discoveries are developed in a work which I have prepared, consisting of about 400 pages, and divided into five parts.'" How lucky for England that the "new Jupiter" had other things on hand, to divert his attention from this most appalling (though not more appalling than *sensible*) scheme of national destruction!—[London Mechanics' Magazine.]

From the Farmer and Mechanic.]

To Dye Woollens.—Last September I was at the exhibition in Burlington, Kentucky, and was much pleased at the spirit shown by the ladies of that neighborhood, in manufacturing so many excellent articles of domestic manufacture for exhibition. For this they deserve great credit; but I observed that in many articles, particularly the carpeting, that though the spinning and weaving were well done, i

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most of them the coloring was deficient, which I attribute to their not having proper instruction in that branch of the business, and have therefore made out the following directions for dying, and I hope you will publish it for their benefit, viz:

Woollen yarn may be dyed yellow by boiling it for an hour with about one-sixth of its weight in alum, dissolved in a sufficient quantity of water, then plunging it, without being rinsed, in a bath previously prepared, by boiling black oak bark, (as ground for tanners,) in water; the yarn is to be boiled in this, and turned until it has acquired the wished-for shade; the oak bark should be strained out of the liquid. It would be of considerable advantage to add 1 ounce of cream of tartar to each pound of alum used. After the yarn is dyed it should be well washed in several changes of water.

Woollens may be dyed blue by dissolving one ounce of good indigo in four ounces of oil of vitriol (sulphuric acid.) This must be done in a glass or stone vessel, powdering the indigo before it is mixed with the vitriol; to the solution one ounce of dry pearl-ash is to be added. The yarn must be boiled in a sufficient quantity of water with one ounce of alum, and one ounce of cream tartar, to every six pounds of yarn; the boiling to continue at least one hour; it is then to be thrown, without rinsing, into a water bath containing a greater or smaller quantity of dissolved indigo, according to the shade wished for. In this bath it must be boiled, until it has acquired the color, and then washed.

Green can be dyed by adding as much of the dissolved indigo to the bark bath, prepared for yellow, as with the proper shade. The cloth having been boiled with alum and tartar, as directed for yellow, is to be put into the mixture, and the same method pursued as directed for dying that color. I would observe that there are many methods of dying blue, many of them practically known in the families of most farmers, and therefore will probably be preferred by them, but this method is most certain and most convenient for obtaining a fine green.

A good red may be obtained by boiling Nicaragua wood in water until the color is extracted, and then straining the liquor; the yarn having been prepared in alum water as previously directed, is to be boiled in it in the same manner as directed for other colors. Different shades may be produced by adding a little copperas.

Wool may be dyed black by the following method—first prepare a bath by boiling one pound of black oak bark, to every ten pounds of yarn, in a sufficient quantity of water. In this bath the wool is to be boiled for two hours, it is to be put into a bath composed of three-fourths of a pound of copperas, and two pounds of logwood, for every ten pounds of yarn, and a sufficient quantity of water; in this it must be kept for two hours more, at a *scalding* heat, frequently taking it out and exposing it to the air during the operation.

A MECHANIC.

A Dissertation upon the Running Gears of Railroad Carriages—illustrating some of their most important natural Mechanical Actions, inseparable thereto; and also describing a remedy for the evils set forth in the Dissertation, embracing principles not heretofore known. Also, a concise description of a Turning Platform for Railroad Carriages—a Curvature to turn corners of streets, wharves, &c., and Grooved Rails for the Curvatures, and the general use of the streets. Also, a newly invented Wrought Iron Wheel, for Railroads. **By JAMES STIMPSON.**

In presenting to the notice of proprietors of Railroads my patent for an improvement in the running gears of railroad carriages, it may perhaps be proper for me to set forth the causes which called for this improvement, together with its advantages over any other mode now in use. In doing this it will be necessary to illustrate the true principles of the natural actions and mechanical motions of railroad carriage wheels as heretofore applied; there being several leading characteristics in their operations inseparably connected with them; some of which are prominent and powerful in their effects; and from the observations which I have been led to make, I am well convinced that they are not well understood, for otherwise their ill effects would ere this have been counteracted. I think I am warranted in my conclusions by the fact, that numberless alterations have been made on both sides of the Atlantic in the running gears of railroad carriages, with a view to overcome the difficulties that have constantly attended their operations.

To common observers the application and use of the running gears of railroad carriages appear extremely simple, and unattended with difficulties—merely round wheels running upon smooth iron rails—and at first sight one would be led to believe that such apparent simple and easy movements must necessarily operate without risk of damage either to the wheels,

the carriage or the rails. But, in order to form a correct opinion upon this subject, it is necessary to observe that the natural course of running of four wheels of equal diameter is only in a straight line, when their axles are kept parallel to each other; and that whenever the railway deviates from a straight line, it becomes necessary, as wheels are now applied or geared to the carriage, to overcome a great proportion of their powerful adhesion to the rails. These facts have not been sufficiently taken into consideration by those who have hitherto endeavored to obviate the difficulties attending the passage of carriages over curves, crossings, crooks, and unequal undulations in railways; yet this adhesion, which must be overcome, very often constitutes the first great cause of all those difficulties, and renders it necessary, as will be hereafter explained, that the wheels should be made fast to their axles, especially when in the least conical; and that to prevent an extra liability of running off the tracks, their axles should be always confined in positions parallel to each other, while their flanches and cones are relied upon to keep them upon the rails, and cause them to conform to the course of the railway. It must also be observed, in order to a correct understanding of the subject, that when the wheels are fixed fast, and set true upon their axles, and their axles are kept parallel with each other, they cannot, without the use of great force, be moved in any other than a straight line, but are in fact, as to any lateral movement, like four fixed props or legs—and it must follow of course that the force, that will be requisite to produce a lateral movement, must be more than equal to the resistance offered by the wheels to that movement; or in other words, sufficient to overcome their adhesion to the rails. Hence it will be readily perceived in what manner the stress of the carriage is brought to operate upon the naves, axles, spokes and rims of the wheels: for whatever power is used to overcome the adhesion between the peripheries of the wheels and the surface of the rails, must act upon all parts of the carriage and wheels, and of course react upon the axles, keys and naves in an inverse ratio of power proportionate to the difference between the diameters of the wheels and those of their axles. Now it is well known that this adhesion of the wheels to the rails is proportionate to the amount of surfaces in contact and the superincumbent weight to a certain extent; as has been illustrated by the experiments of Mr. George Rennie, Fellow of the Royal Society, London, and ascertained by him to be equal to forty-three per centum for seven hundred and nine pounds upon a square inch—or for every square inch of wheel and rail in contact.

By a calculation based upon these facts it will be found, that upon rails of the usual width, each wheel of a carriage, with a common load, adheres to the rail with a power of more than three hundred pounds. Now to produce an instantaneous lateral movement upon the rails, three of the wheels, as now applied and used, must slide, while the fourth will only have to oblique a little, or twist as it were, in order to conform to the direction of the others—and, by the way, this obliquing or twisting alone produces a damage to the rails and wheels equal to the force exerted by their adhesion together—and hence the great impropriety of using vibrating axles; for it is well known that they are made to oscillate or vibrate far beyond what is necessary to enable them to follow the true course of the road, besides that produced by every considerable impediment to motion under the peripheries of the wheels. I therefore propose to consider some of the most important effects produced by different modes of construction as they suggest themselves to my mind; and also the remedy.

The natural power of adhesion of the Wheel to the Rails.

The adhesion of one wheel being equal to three hundred pounds, that of three wheels will be equal to nine hundred pounds; therefore, a force more than equal to that resistance must be exerted by something in order to overcome it, whenever a lateral movement is required—and it must be borne in mind that this force, when one wheel has to move all the rest laterally, reacts upon the axles, keys, wedges, pins, or whatever may be used to fasten the wheels to the axles, with a power inversely proportionate to the excess of the diameter of the peripheries of the wheels over that of the axles—which is in most cases as twelve to one, and consequently amounts to ten thousand and eight hundred pounds at the nave of the wheel which produces the movement; and three thousand and six hundred pounds upon each of the others at their naves; and as roads are made in this country with frequent curvatures in different directions, and also with crossings from one track to another, when the power to be exerted is still greater than upon curves, this stress upon the axles and wheels is acting and reacting almost constantly. Who then can be surprised at their early destruction?

The means relied upon to change the direction of the Carriage.

Let us now inquire what means are pro-

vided and used to effect a lateral movement, and to overcome the above mentioned resistance thereto; or in other words, to change the direction of the carriage and cause the wheels to follow the track without force; keeping in mind at the same time that from the causes before stated the wheels will run only in a straight line, and that they are held in that course by the parallelism of their axles and their power of adhesion—that is to say, a power of adhesion equal to three hundred pounds for each wheel at its periphery—and we find that a *single cone* is all that is relied upon to effect the object and to change the direction of the carriage when required.

The amount of the adhesion of a cone compared with that of the tread of the Wheel.

Let us next inquire what power one cone has to enable it to overcome the resistance of nine hundred pounds; which will be the resistance of three wheels when one cone acts alone, as before stated. Now, the power of adhesion being proportionate to the bearing surface and weight, up to seven hundred and nine pounds for each square inch of wheel and rail in contact, it follows that when a cone comes with its obtuse angle in contact with a flat horizontal rail, its bearing surface is thus reduced to less than one fourth of that of either of the other wheels, which, at the moment when the cone begins to act, are upon their treads, its power of adhesion by its reduction of bearing surface is thereby reduced to less than seventy-five pounds. How can a power of seventy-five pounds, acting with no extraneous advantages, produce a change in the direction of the carriage, which is held in its straight course by a power of nine hundred pounds? It must be admitted that it is impossible. It follows then that the wheel on its cone must itself slide as much as its periphery exceeds that of either of the wheels running on their treads; and that it must continue to slide in that proportion until the vertical part of the flanch impinges against the edge of the rail, when the resistance to a change of direction in the carriage will be overcome by main force; that is, by means of the flanch. This will always be the case, unless the full size of the cone on the hind wheel, or a diameter thereof corresponding to that of the front wheel upon the same side of the carriage, comes in contact with the rail in time to act before the flanch of the front wheel is caused to impinge as aforesaid, for then the direction of the carriage will be changed by the joint action of the two cones, which have a leverage power over their two fellows equal to the length of the axles; and as the wheels upon their treads have only to oblique as they roll, and not to slide, they will yield to the action of the cones of their fellows.

When the direction of the carriage is about to be changed or turned from a straight line at the commencement of a curve, the fore and hind wheels on the outside of the curve cannot be in contact with the rail upon equal diameters simultaneously; consequently there must be a sliding somewhere until the hind wheel reaches the point where the curve commences and runs upon its cone to a diameter corresponding with that of the fore wheel: during all which time the strain upon the fastenings and axles must be in proportion to the power of adhesion, &c., as before described. To this cause we may ascribe the early destruction of the wheels by the wearing out or indenting of the surfaces of their cones, and their constant tendency to work loose; and hence also the danger of using large wheels, unless the size of the axles be also large.

The ill effects produced by the cone not being able to change the direction of the carriage in season, and also why it is not changed, &c.

There is one extremely pernicious effect produced by the forcing of the wheels on one side of the carriage upon a higher part of their cones than is necessary before they are able to turn the carriage into the true course of the railway, to which I would call particular attention.

It is a well known fact, and has often been observed by travellers on a railroad, that the carriage will run from one side of the railway to the other, producing a kind of vibratory motion extremely unpleasant to the passenger. This is caused by the cone's not being able to change the direction of the carriage in season as before stated, and which is produced in the following manner: The wheels on the outside of the curve or crook at its commencement having been forced to run upon the very highest part of their cones by the causes herein before enumerated and explained, that is, want of power to change their course, they are in contact with an increased diameter to an extent that causes them to have a tendency as soon as they can act to turn a much shorter curve than that required by the railway upon which they are running: so that they necessarily cause the carriage to give a rank shear across the railway, the true course of the railroad. This vibratory motion will be produced, not only by curves and crooks, but by any unequal undulations or unevenness in the surface of one track of the railway, more than the other: thus, when it becomes necessary for one wheel to describe more space in the

same time than either of the others—and from the causes set forth it cannot do it—there must be a dragging or sliding, which, whenever it does occur, an immense stress upon the wheels is produced, and a proportionately unnecessary wear to both rails and wheels.

The improvement will allow the carriage to change its course of direction with perfect ease.

One of the beauties of my improvement consists in its being a complete remedy for the evil consequences above set forth — for this improvement permits a single cone to change the direction of the carriage the instant it touches upon the rail at the commencement of a curve, and steer it precisely in the course of the railway, without causing the flanches to impinge against the rails, or producing any stress upon the axles, the wheels, or the carriage.

The importance of the improvement at the crossings.

But when the carriage is about entering a switch at a crossing the importance of this improvement becomes immense; for it reduces the force of action or stress between the flanch and switch more than one-half; which is a great security against its running over the switches, and cutting away their top edges or breaking the flanch by the force of the blow.

Large Wheels may be used, &c.

By the application of my improvement, large wheels, if made in a proper form, may be used with safety where the tracks have no very short curves, and without increasing their weight or that of the axles beyond what would be their due proportion for their increased size, without any regard to the stress caused by adhesion, &c. With respect to the size of wheels, there is something to be said in favour of both large and small. Small wheels are lighter, safer in turning short curves, and easier to load heavy goods upon: but the smaller the wheel the less the bearing surface upon the rails: and the more rapidly will both wheel and rail be cut and worn away by the crushing of gravel between their surfaces, and also the metal itself. Small wheels make more revolutions in a given space, which creates more heat at the gudgeon and consumes the oil much faster. They also require more power to move them; and when passing over stones or any uneven places in the tracks, their concussions therewith are much more severe and injurious to wheels, carriage and rails, under equal speed, than when the wheels are large; and therefore they are more unpleasant to passengers both in their actions and on account of the noise they produce. When the roads are nearly level and tolerably straight, I should prefer wheels of thirty-six to forty-two inches in diameter for passenger cars that are intended for speed; and with the use of my improvement wheels of this size will cause less expense per annum, taking every thing into view, than smaller sized wheels.

When the wheels are composed partly of iron and partly of wood, and the stress naturally resulting to wheels made fast to their axles is properly considered, together with the effects produced upon them by the variations of the weather, the immense importance of the easement to motion, and relief from lateral or other strain, afforded by the application of my improvement, becomes the more conspicuous. Indeed for such wheels the use of this improvement is as indispensable as iron shoes are to horses upon hard roads.

The saving of power to a locomotive that would be made by the application of my improvement throughout a train of cars, is worthy of particular consideration; for without it in the same sliding of the wheels, which has been before spoken of, would appertain to each car, and thus the resistance resulting therefrom would be increased to a large amount by the number of cars in the train. It would thus require a proportionate increase of power to overcome this resistance; the exertion of which would produce extra stress upon the engine and boiler, and render it necessary to keep up the fire by an extra quantity of fuel, the excess of which heat is most certain to destroy the fire pipes. Now if the train of cars of the same weight can be moved over the same road with fifty pounds of steam instead of sixty, the saving is more in every respect than it would at first sight appear to be, and more especially in respect to the effects produced upon the engine, boiler, flue, pipes, &c.; for the higher the pressure of the steam the more power is requisite to move the valves, consequently they will wear out faster in all their connecting parts and get out of repair much sooner, and the more liable will the joints of the boiler, the pipes and all parts be to fail; and when the least thing does give way, all operations or movements are brought to a stand. The cost of the locomotives at the lowest estimation, embraces an item of expense which should leave no auxiliary to their duration and safety unnoticed.

The bad tendency of loose wheels — they have no power to guide the carriage.

As a means of avoiding the evils attend-

ant upon the use of wheels made fast to their axles, resort has been had to wheels loose upon their axles—but to this mode of gearing there exist inseparable objections, which prove that the remedy is far worse than the evil; for the wheels themselves are rapidly destroyed at their naves and peripheries—the axles within the naves, with the collars and washers, as well as the rails themselves, are also subjected to an immensely increased wear and tear. Besides these evils there is a great loss of power, for loose wheels have not the power to guide the carriage, and the consequence is that their flanches will continually impinge against the edges of the ails, and thus the flanches and rails will cut each other in proportion to the power of adhesion which the treads of the wheels have to hold the flanches up to the edge of the rails. Nor have loose wheels the power to guide the carriage even when they are provided with cones upon their peripheries; for when the carriage approaches a curve, the front wheel, which first meets it, must run up upon its cone; the effect of which is, not to guide the carriage, but to impede its own motion, for being loose, it acts independently of its fellow wheel upon the same axle, and of course when its periphery is increased, instead of its acting as a guide to is fellow, it will merely describe the same space at the same time without turning so far on its axle. Its own motion is impeded, because in the very act of running up upon its cone, it runs as it were up-hill; and its diameter being increased, it is thereby made to sustain more than its due proportion of the weight of the carriage and load; both of which circumstances produce resistance to is advance. Nor will the direction of the carriage be changed until the flanch of the wheel strikes against the rail, and then the direction will be changed, but the flanch will grind along against the edge of the rail, producing an immense resistance to its own progress, and great injury to itself and the rail.

The facts must be obvious to all who have given best subject a thought. The wheel at the can have no more power of itself to change the direction of the carriage, than the amount of adhesion of the inside of the nave to the axle; which is of itself totally inadequate to the task.

But there are other ill consequences attendant upon the use of loose wheels, some of which I will endeavor to point out. Immediately after the flanch upon the front wheel touches the rail, that of the hind wheel will do the same—when their united resistance to motion will cause that side of the carriage to lag, and if there is any play in the joints of the transverse rails of the carriage where they join to the cheeks, it will cause the wheels on the other side of carriage, (which always run free when flanches of their fellow wheels are in contact with the rail,) to get in advance, and thereby keep the flanches of their fellow wheels crowded up to the rail on the other side, by the course of their own direction, and keep them continually in contact therewith.

The inclination of loose wheels to gather in at the bottom if conical, and the ill effects resulting therefrom, &c.

Again, wheels that are formed in the least conical upon their treads will incline or gather in towards each other at their points of contact with the rails, in the same manner as a leather belt inclines to the largest part of a pulley, and with a power equal to that of the adhesion of the wheels to the rails. This tendency to run in has no other effect upon wheels made fast upon their axles, when both they and their axles are sufficiently stiff or strong, than to keep them upon a constant strain inwards at their points of contact with the rails, and to bend or spring the axles upwards; but upon wheels loose upon their axles the effect is almost incredible, the power exerted upon the axles at the exterior edges of the naves is equal to three thousand and six hundred pounds; for in medium sized wheels the leverage power of the periphery over the inside of the nave is as twelve to one, by which if we multiply the estimated power of adhesion of one wheel, or three hundred pounds, we obtain the result aforesaid. It must be evident to any one that such a power constantly exerting itself, or in other words, grinding upon the axles at the exterior edges of the naves, must soon wear them larger outward from their centres each way. It may also be observed that every time the wheels turn round there must be a constant tendency to oblique from a perpendicular line, if there be any loose play between the naves and axles; for the sides or points of the wheels, which were last in contact with the rails, were of course within a plumb line through their centres when compared with the sides or points immediately above—and they must be as much without that plumb line when at top as they were within at bottom—so that in changing from one position to the other they must be constantly obliquing. Now as three feet wheels turn around five hundred and eighty-four times in a mile, the griping force as before set forth of three thousand and six hundred pounds is constantly acting upon them in addition to the weight of the load, the carriage, and the power necessary to

manage and control the wheels—so that no one can be at a loss in accounting for the early and rapid destruction of the naves and axles, when the wheels are left loose, or for that of the collars and washers within which the naves revolve; and more especially when it is considered that all these movements at the naves, besides being under such a stress of power and weight, take place in a situation extremely exposed to the deposite of dust and dirt; for the wheels generally run so fast that the dirt is thrown from their peripheries up against the carriage or covers of the wheels, and even into the air, whence it falls upon the axles, there to mingle with the oil, to work in between the moving surfaces about the naves, and necessarily to impair them very fast. Thus they soon become so very loose upon their axles as to render their passage through a crossing or round a curvature extremely dangerous.

And again, a mere trifle of loose play between the naves and axles, allows considerable variation from a perpendicular at the peripheries of the wheels, and thereby cause their treads, although conical, to lay flat upon the rails: from whence it necessarily follows, that as much as the inside of the tread is larger than the outside, so much the outside has to be slipped along over the rail to a great loss of power and extra wear of both wheel and rail. To obviate these difficulties in part, one wheel has been made fast upon each axle and the others left loose; but practice at once proved that the stress upon the loose wheel was quite doubled, and its destruction made rapid in proportion—and the use of loose wheels has been abandoned on account of the cost of repairs, and their total inability to guide the carriage.

Thus it is manifest that the natural tendencies of loose wheels are to their own rapid destruction, and that therefore they are inapplicable to the use—and the only remedies supposed to be left to obviate some of the principal difficulties that have been enumerated, was to be found in the use of vibrating axles or small wheels made fast to the axles. It is well known that by a reduction of the size, the stress at the axles would be reduced, and that the risk of breaking them, when it became necessary for any of them to slide, would also be reduced; and this effect was necessarily produced by the change. But they are after all subject to all the extra wear produced by sliding, and to the stress upon the wheels, axles, keys and carriage, which has been already alluded to; that is exactly all that stress in proportion to their size; while at the same time their liability to run off the track is proportionate to the difficulty of changing their line of direction upon the rails at the commencement of a curve.

Vibrating axles—the bad tendency thereof, &c.

I have before said there was an impropriety in using them, and it may be proper here to give the reason. I will first however call attention to the usual and necessary play allowed between the flanches and the inner edges of the rails—this play is about an inch and three quarters, more or less, but the less the better, where the curvatures of the road will admit of it, as from a proper attention to this point alone greatly depends the injury to the road, the carriage, and the liability of running off the road. For example, we will suppose the flanches of the fore and hind wheels, upon the diagonal corners of a carriage, whose axles are confined in a parallel position, to be close up to the rails each way, and that the axles are coupled three feet six inches apart, consequently all the angle across the track that could ever be formed, would be that of one inch and three quarters to forty-two inches; this angle is so slight that when the flanches do touch, their power of action either to injure the flanch or rail, or to spread the rails apart, is of course lessened in proportion to the acuteness of the angle; this position being well understood, that which follows will be fully comprehended. Now with vibrating axles there is need of as much loose play between the rails and the flanches, as is allowed to fix axles, and even twice the distance is allowed; let it be more or less, it is certain that when the axles are allowed to vibrate sufficiently to conform to the plane of the radius of a circle of four hundred feet, and when the fore axle is up to the extreme limits of its vibration on one direction, if the other is exactly square with the frame of the carriage, the angle of the other with the track would be twice as obtuse as the one with fixed axles can be in the same relative position; but if the hind axle was thrown in a contrary direction to the front, which must and often will be the case, even by their own action or the formation of the track, and very often from extraneous causes, such as impediments to motion upon the rails causing a slipping, &c.; then the obtuseness of the angle becomes three-fold, or in other words, it has three times the power to run off the track that the fixed axles have.—Should this position of the axles happen just at a crossing or curve in the tracks, and the curve be across the set of the wheels, then the course of the wheels would be almost at right angles with the line of the road, and the power to run off the rails six times as great as the fixed axles. It also

follows that the power to spread open the track is increased in the same proportion, for when the flanch is locked or hard up to one rail, it can go no further in that direction, and the wheels upon the other track act with all their power of adhesion to force the rails apart; hence the lateral strain upon the boxes, or if friction wheels be used, the lateral pressure will be against their backs, acted upon by the ends of the axles, all of which has a powerful tendency to rack and loosen the joints of the carriage; for whenever one axle runs across the other, a constant slipping of the carriage transversely upon the axles takes place, and the lateral pressure against the shoulders of the axles, if they have any, and sides of the boxes, or against the back of the friction wheels, by the ends of the axles, is far more than can well be imagined until the principles of the action is well understood, or the powerful and destructive effects shown by examining the parts. I have seen many backs broken out of friction wheels from that cause alone, vibration —and the greater the play allowed between the ends of the axles and the backs of the wheels, or the shoulders upon the axles and boxes, the greater will be the damage; for the carriage will slide off and on transversely upon the axles, with all apparent ease, as if it weighed but a single pound.—It must be obvious that the greater distance such heavy weights are allowed to move, the more violent will be the injury here spoken of when bringing up. My joint is a perfect remedy for this evil, as my experience has demonstrated.

There are other considerable objections to the use of vibrating axles, to which it may be proper here to allude. They will keep vibrating almost constantly, and cause a continual chafing of the wheels and rails, which the fixed axles would not, producing a very unpleasant sensation upon the minds of the passengers. This constancy of vibration arises from the obtuse angles or rank shear the carriage wheels obtain across the track; for it is certain that one rank shear cannot be overcome or mended without making another, and this is owing to the fact that they must run up a greater distance upon the cones to overcome the shear than the track itself requires; it therefore turns off not exactly upon the line of the road ahead, but across it, and there it meets with the same difficulties, unless it has passed upon a piece of road favorable to its true adjustment. But should the road be unfavorable to such adjustment, then the vibration, and consequently the difficulty, would be increased double, and often three-fold—this could never take place with fixed axles. In order further to illustrate this position, and to show the true cause of this vibration, which is to be found in the position of the carriage or axles, we will suppose the range of the axles to deviate ten degrees from that of the track, and that both axles are parallel to each other, it necessarily follows that the front wheel which first arrives upon the cone, cannot change the direction of its axle, until it runs far enough to gain upon its fellow sufficiently for that purpose, and also to overcome the obtuse angle the carriage or the hind axle had at the outset; so that the distance the carriage will go ahead before it can turn off is much farther than was necessary to properly adjust it to the true range of the track; that is, when the front wheel had arrived upon that part of the cone proper to run the track, the hind wheels had not, and the front consequently has to run enough farther ahead, still upon an oblique direction, to adjust *both points*, and thus overreaches its proper *position* by forming a circuit as it were in making the change; and thus having gone too far, it of course turns off the contrary way, and then ensues the same difficulties as before, and so on continually. All that can be said in favor of vibrating axles is that in certain situations they will prevent a slipping of the wheels upon the rails; but the extra wear from the more frequent vibrations, the loss of power, and above all the great liability to break the flanches and to run off the tracks when under much speed, will by far outweigh all the benefits they possess. To use vibrating axles with friction wheels is contrary to the generally received and common understanding of mechanical principles, at least so far as I comprehend them. Indeed the absurdity to my mind is so great that nothing but having actually seen it in use would have induced me to believe it.

An experiment to prove the transverse inclination of conical wheels.

I am aware we have been told by very learned gentlemen in mechanics that when the axles and wheels are so stiff that they cannot spring or give way in any *perceptible* degree, that the tendency of the wheels to incline or gather at the bottom could not take place, or the separation of the rails ensue, because, say they, when there is a little or no inward movement, no such effect can be produced. I cannot however see it in that light, for I have applied means, and put myself to some expense to try it in a way that cannot deceive. I will here state the result of my experiment, that others may be the better able to judge. In a horse locomotive which I invented some years since, I had wheels four feet in diameter, cast iron naves, wooden spokes and fellows, their

peripheries were turned in a lathe perfectly round and cylindrical, and then tired with rolled iron plates, the flanches bolted upon the sides of the fellows, so as to make them very strong; the hubs were drilled out to fit close upon the axles, and each wheel was revolved upon its axle between collars and a cap: the cap was fixed fast upon the axle, outside of the naves, by a strong key running through it and the axle, and was made as large as the outside of the nave of the wheel; both were turned true and faced up to each other; within each of these caps were two catches, which acted against rack teeth in the face or end of the nave, to turn the wheel. The power of action being applied to the axles, the catches turned the wheels as fast as the axles, but they could turn faster at all times when necessary. In 1829 and '30 I run it with the peripheries entirely cylindrical, and it went perfectly smooth, still, and free from any lateral movement or pressure. Being so well prepared to carry out or prove my views in regard to the transverse action or conical wheels, I paid Mr. George Reader 25 dollars to turn the tires conical. I put them to work, and the instant they started they inclined inwards at the bottom. They had not revolved fifteen times before they made a jump outwards, (to do which it was necessary to overcome the whole adhesion of the wheels to the rails,) and so continued to act as long as I used them; that is the wheels would run in towards each other at the bottoms until the strength of the spokes and rims could no longer yield, and they would then spring outwards to a vertical position. I could perceive there was an easement to forward motion the instant the wheels were upright by the movement of the car, much the same as is observable in steamboats by the engines passing their dead centres. The retardation of the car arose from the outside of the wheels being smallest, and of course having to be slipped upon the rail, while they touched upon the whole width of it, as much as the outside of the wheels were smaller than the inside. As soon as the wheels were upright the greater part of the resistance was removed, as the bearing surface was contracted.—The powerful effect of this action inwards, pressing the naves of the wheels against the collars and washers, was such that I found it necessary to put in washers an eighth of an inch thick nearly every ten days of use, to prevent the wheels from falling in between the rails. Mr. Washington, of the firm of Majors & Washington, made the washers, and he saw and knew the cause of the destruction: I mention his name that he may be applied to if desired. I am well convinced that the damage at the nave and upon the axles, collars, &c. of loose wheels, is so great, (unless their diameters be very small,) that the advantage of their not slipping cannot compensate for the additional cost caused by their speedy destruction, and more especially if the treads be in the least conical.

Let us next inquire why they run in when conical, and not, when cylindrical: The naves being six inches long, drilled out straight in a chuck lathe, and the weight of the carriage, with two horses, and three to fifteen persons, one would think, resting upon the inside of the naves, would certainly have some tendency to keep the wheels upright; for when out of plumb, the bearing, if there were any loose play in the naves at all, must be upon the extreme inner edge of the hub, requiring some power surely to raise it in that position; at the same time the naves were placed between the cap and collars, and keyed up as close to each other, when first in operation, as they could be. Their running in notwithstanding shows that there is a natural mechanical tendency to run in, whether the strength of the wheels and axles yield to it or not, especially when it had to overcome a very great opposition, at the very instant it commenced.

I should prefer to have all that part of the wheels outside of the cone entirely cylindrical, there being but one part of the road where they can be injurious, and that but a small portion of it, and even there it may be remedied by a proper mode of forming the iron plates; the portion of the tracks to which I allude, is the inside rail of a circle. When a cylindrical wheel turns upon a flat horizontal rail the bearing in contact will extend across the whole width of the rail, the outer edge of the inner wheel must therefore be retrogading, or twisting, as it rolls around the curves, nearly as much as the outer edge of the rail is shorter than the inside; but if the inside rails were rolled with an elliptical face, or made thickest on the inner edge, then the bearings might be contracted as much as it might be desired. Under this mode of construction the difficulty would be removed. Should the rails become worn down flat, the cones would also by the same time wear away the inner edge of the outer rails; the rails would then only require to be changed, one for the other, so as to reinstate them nearly as at first.

A reference to common coaches, so as to understand the use of the joint, &c.

Having described the nature of some of the most remarkable and important difficulties that exist in the operations of wheels as now used upon railroad carriages, which

it is the object of my improvement to obviate, it may be proper to make a few remarks upon its utility and easement to motion, in order to make its merits obvious and familiar to those who may not have had an opportunity of becoming acquainted with the operations of railroad carriages: and I will illustrate the subject by reference to the operations of common coaches. In these it is well known, that the pole at the fore axle is the means by which all the wheels are guided, that all the wheels are loose upon their axles, and that when going in a curved line or direction, the hind wheels follow nearly in the track of the fore ones. Now it will be easily comprehended, that when turning a curve, the wheels upon the outside of the curve must necessarily turn round faster than those upon the inside, because they have to run a greater distance. But suppose the wheels upon the hind axle were made fast; in that case, the wheel upon the out side of the curve, instead of rolling faster, would be dragged along as much as the distance described by the wheel on the outside exceeds that described by the wheel upon the inside of the curve, or if this does not take place, the inner wheel must slide back: for one or the other must necessarily slide, and in either case the stress upon the naves and axle will be the same, and the necessary extra power to turn them, just equal to that of slipping the wheel.

We will now apply the same facts to wheels on a railroad carriage geared according to my improvement, and consider the cones upon the fore wheels, both of which are to be made fast to their axle, as the pole of the coach, and the joint in the centre of the hind axle, as a substitute for the loose wheels on the coach; and it will be readily perceived that the carriage will then turn a curve with the greatest ease; for the joint in the hind axles permits the hind wheels to act independently of each other, and thus enables one to describe a greater space in the same moment of time; thus preventing the necessity of any dragging or sliding of the hind wheels, and thereby leaving the cone of the fore wheel in possession of full power to guide the carriage in the direction of the track: which it will be able to accomplish with as much ease and certainty, as a coach is guided by means of the pole. With this joint the cone of the fore wheel will be much more efficient in guiding the carriage than it would be, if, instead of the joint in the axle, the hind wheels were left loose upon their axle—for when the wheels are made fast, the axle, although it have a joint in its centre, turns with the wheels as if it had no joint, and the bearings of the axle are but two inches in diameter: but when the wheels are left loose, the diameters of the bearings of the axles within the naves of the wheels are required to be nearly three inches, which, by increasing the amount of surface in contact, increases the resistance to the revolutions of the wheels in the same ratio—to which should be added the friction at the end of the naves, against the collars and washers, and the griping or grinding power of the naves upon the axles, produced by the inclination of the wheels to run in at their points of contact with the rails, as before stated, together with the effect produced by the weight of the load and carriage. It will then be clearly perceived by comparing the two modes, that the hind wheels will much more readily conform to the movements and guidance of the cones upon the fore wheels, when they are made fast upon an axle with a joint in its centre, than when they are left loose upon an axle without a joint—for at the joint there is no friction of importance produced by the superincumbent weight. Indeed the hind part of the carriage by means of the joint will yield to the action of the cones as easily as if centred upon a pivot.

It is also worthy of remark, that the joint is two feet and nine inches from the centre of the wheels at their naves, so that it possesses a leverage power, proportionate to that distance, to hold the wheels in an upright, steady and firm position, and save itself from being cut by its own slight movements.

What then can be more simple, safe and consistent in its practical operation and effects, than this joint, to consummate that grand object for the attainment of which such a multitude of changes in the mode of gearing wheels have been made both in Europe and America since the first introduction of railroads—and without it, those changes would necessarily continue to go on; for it has been abundantly evident, that when the durable nature of the materials made use of is taken into consideration, a sufficient remuneration in their increased duration has not been realized. *But on the contrary* it has been manifest, *that* there existed some hidden cause of destruction, far exceeding that to which carriage operations upon common roads are comparatively liable.

I have thus endeavored to point out as distinctly and concisely as possible the difficulties necessarily attendant upon the operations of the wheels of railroad carriages as now geared and used; and I am satisfied that the remedy I have provided will be amply sufficient to accomplish the object for which it is intended, and that when carried into operation, it will prove entirely satisfactory and become the standard in fu-

ture operations. I flatter myself that no further alteration or amendment will be requisite, for nothing can surpass it in simplicity and efficiency. For a period of more than four years, I have been engaged more or less in testing its utility in practice, and I am certain that I cannot be laboring under any delusion or mistake as to what I have stated in relation thereto. I have forborne to give publicity to this improvement hitherto from a desire to prove its utility and practical efficiency to my complete satisfaction at my own leisure and expense, as well as to give time to others to try their different projects, that they might perceive how difficult, and yet how important it was to provide a remedy for the difficulties which they have been laboring under, in hopes that when made known they would be the better able and the *more willing* to appreciate its value when understood and realized.

Formation of Wheels, &c.

Before closing my remarks I will observe that the peripheries of the wheels should be made perfectly cylindrical or horizontal as to all that portion thereof designated and known as the tread, and that the inclination and breadth of the conical part of the peripheries should vary according to the radii of the curves in the tracks on which the wheels are intended to run—and the distance between the foot of the cones on each side of the carriage, when it is standing centrally upon the rails, must be a trifle less than the distance between the inner edges of the rail plates; so that running on a straight line of road no portion of the conical part of the peripheries of the wheels shall come in contact with the rails.

My reasons for preferring this form of wheels are, that when running upon their treads or cylindrical faces, which they will always do when the road is straight and both rails are equally level, they will have no tendency to run in towards each other at their points of contact with the rails; and that therefore the naves and axles will be relieved from the stress upon them, produced by that tendency when the wheels are conical—and that while running upon a curve, the cone, by the relief or easement to motion afforded by the application and use of the joint, will follow its own natural course upon the track, and thus all lateral strain will be obviated; and in no part of the operations will there be any sliding, if the wheels be made after the proposed form. When the treads are entirely cylindrical the top of the inner rail should be elliptical to prevent chafing. But particular care should be taken to have the size of the treads of the two wheels, which are to be fastened upon the fore axle, which has no joint, exactly alike as to circumference as it is possible to make them—for if they be unequal the smaller will be thrown upon the foot of its cone as much as will be required to equalize the circumferences of the two wheels, and thereby wear away or indent the face of the cone and leave in it an abrupt shoulder. No caution of this kind will be necessary with respect to the wheels upon the hind axle which has a joint, as the joint alone obviates all the difficulty. This circumstance affords a choice, for equality of size, of two out of every four wheels, to fasten upon the fore axle.

From all these circumstances the liability of breaking the axles or wheels, or of working them loose, will be reduced to a mere trifle. Indeed the hind wheels may be sufficiently secured upon their axle without the use of either keys or pins, by merely staking them up upon the outside of their naves, if the holes within the naves be made to receive the axle, and the axle itself be made a little tapering, that is, smallest at the outside. Even the breaks will produce no stress upon the axle or the naves of the wheels upon the hind axle; as a break can have no influence upon the wheel opposite to that to which it is applied.

I have left several minor points unnoticed, not feeling myself competent to do full justice to the subject; but have submitted to the task thus far from the necessity of setting forth the causes which called for my improvement; and have contented myself with touching upon the most important points, in hopes that the so doing would lead to a full development of the subject by those more competent than myself.

Description of the Joint.

The joint alluded to in the foregoing observations may be constructed in the following manner: The axle intended for the after part of the carriage should be made in two parts, to meet in the centre between the wheels, their ends upset sufficiently to form a flanch, in the finish, say one quarter of an inch larger all round than the axle, and about the same in thickness; they should be turned exactly of a size, as well as the axles outside the flanch, as far as the coupling box is intended to reach, and their ends made somewhat concave below, or a little within the base of the flanches, to prevent any leverage over the centres of the axles, to press them apart. The coupling box should fit the axles exactly, and have a groove turned into its centre sufficiently deep, and wide, to receive the flanches when placed close up to each other. The coupling box may be closed over the axles by screw bolts, and nuts; or hoops may be shrunk upon it, or drove on, and then cut

up a little outside of the hoops, to prevent their slipping off, the box being formed a little tapering each way from the centre, with a projecting ring, or rib round, larger than what is turned out of the inside, to receive the flanches of the axles. Care should be taken that the coupling should be so strong that when fastened upon the axles the strength at the points of junction, shall be equal to any part of the axles. The box should be about one foot long. One axle can thus turn independently of the other, and yet be so well fitted that it shall have no loose play in any direction, except to turn round. It will be seen that when running upon a straight road, if all the wheels were of equal diameters, which, by the by, is very seldom the case, there would be no movement of the axles within the coupling; and when running upon a curve, if the axle was two inches and three quarters in diameters, and the wheels thirty-six, it would there be only in movement, as two and three quarters is to thirty-six, while the distance the coupling is from the wheels, affords so much power over the wheels by leverage, that but a very small degree of stress within the box can be brought to act upon it. Now let us consider the effect of the steering power afforded by the joint: the hind wheels must yield to the slightest impulse, the cones then upon the forward wheels can direct the course of the carriage with nearly as much ease as though they were running by themselves independent of the carriage, thus steering a direct course with the road, and at the same time effecting what was contemplated by the use of vibrating axles, while it avoids the dangers resulting therefrom, and this too, with wheels all made fast to the axles, and the axles themselves kept perfectly parallel to each other, and thereby avoiding all the injury and loss of property resulting from the application of loose wheels, and saves as much of the propelling power in their movements as is necessary to make the wheels slip upon the rails. I have no doubt that one set of wheels with this improvement, will out last two sets, as now used upon roads as serpentine as that of the Susquehanna, or Baltimore and Ohio. No article so trifling in itself in use at the present day upon railroads, can in any way compare with it in usefulness! I have used it under all speeds up to thirty-three miles per hour, and could never perceive a difference in its action.

Description of the Turning Platform, &c.

It may be useful and satisfactory to mention that I have also obtained a patent for a turning platform, to turn railroad or other carriages upon. The platform turns upon a ring projecting underneath, resting upon the tops of twelve conical rollers, while the rollers themselves run upon the top of a cast iron ring of the same size, both of which are near to the exterior of the platform, so that there is no liability of its rocking about; and there is no friction worth mentioning, arising from the superincumbent weight of the carriage and load; which is in practice a benefit about the same as to enlarge the centre of a pivot, so as to extend to the exterior without increasing the friction. The main object of my mode of construction, is to secure a permanent level surface with the adjoining track rails with an easy movement which a centre pivot will not long do; for when worn a trifle at the centre it will cause a great deviation at the exterior from a level; and the foundation is far more expensive, and difficult to keep in repair, to insure a perfectly horizontal position, when acted upon by the centre of the platform only. Those laid in the centre of Pratt street in the city of Baltimore are of the kind above described.

I have also two patents for a mode of turning corners of streets, wharves, &c. One of them is for the application of the *flanches* for that purpose. It is effected by the wheels upon the outer track of the curve's running upon their flanches, while the wheels upon the inner track, run upon their treads, which are about two and three quarters inches less in diameter than the flanches. The other patent is for the railroad plates necessary to form the curvature; and also for *grooved* rails for any parts of the streets, made of wrought or cast iron, so constructed that no description of carriage can be injured in passing in any direction over them. They are indeed a real improvement to the common travel of the streets, at the same time less liable to injury of themselves, than those of any other I have seen.

I have also invented a wheel for locomotive use, and especially for passenger carriages, which is no doubt superior to that of any other known, for the following reasons: From its peculiar formation it may be made lighter by one half, than any other, and at the same time twice as strong. It is composed entirely of wrought iron, excepting the hub, and no bolts or rivets are used in its construction, a desideratum long desired, and sought for. It will unquestionably become the standard for all the purposes where speed and safety are esential.

[From the New-York American.]

As the attention of our city authorities seems directed to the subject of paving the streets, it has occurred to me to suggest a mode different from

any in use in this country, and which yet seems more applicable than any other to our city. This is the system of laying flat cut stones, nicely jointed, for the wheels to run on, leaving the rest of the road in its present condition. In Broadway there might be four rail ways—if I might so call them—of this nature; two for carriages ascending, and two for those going in the other direction. The effect of this system would be to keep vehicles to their proper side, more than is now practised, and to obviate those disasters so common in our streets. The wear and tear of horses and carriages that would be saved by this mode of paving, would be immense, and would soon repay the expense of the alteration. If it should be objected that these railways, by keeping vehicles in rows following each other, would reduce the whole of drivers to the same gait, it may be answered, that after all, the pavement would be no worse in this respect than it is now; but that, on the contrary, in consequence of the greater order, it would be much easier for fast drivers to turn out. It might, moreover, be advisable to confine loaded vehicles, going at a walk, by law, to a particular portion of the road.

This plan of paving is neither new nor speculative. The streets of Milan are all laid in this way, and those who know that delightful city, will join me in attesting the ease with which they are traveled. In London, moreover, the road from the West India Docks to Wapping has been furnished with a track of this description, by means of which a single horse is able to draw a weight of sugar, which four would not be able to move on the ordinary pavement.

X.

[From the same, of Sept. 28.]

City Affairs.—Under this head we publish a communication to-day, that appears to us to present some most important views, as to the necessity of immediately improving the streets, and avenues of the upper part of the island.

It is in this way that lots distant from the thickly settled parts of the city, may be put within the reach of mechanics and young beginners, who have their fortunes to make, instead of compelling them, by high rents, to seek dwellings over the rivers that bound us.

A railroad too, that should bring people down into the heart of the city, is now, we are well satisfied, a desirable improvement. We thought otherwise when such a scheme was first proposed, but the impassableness and dangers of Broadway, by reason of the *omnibusses* and other vehicles, which constantly crowd it, have convinced us, that rail cars, following a given track, from which they cannot deviate, drawn by horses, and announced by bells, as in the sleighing season, would be altogether safer, more convenient, and more advantageous to up-town residents.

[For the New-York American.]

City Affairs.—The recess, which the members of the Common Council took during the month of August, has probably enabled many of them to notice the improvements in contemplation, in the different towns and cities in this section of the Union. They could not have failed to observe that the provisions, as compared with their respective present populations, for future increase, every where else, vastly exceed what our own city exhibits. I have not seen the returns of the census now taking, but computing our population according to the number of lots assessed as occupied, it cannot be less than 285,000, or an increase of 40 per cent. since the census of 1830, which gave 202,960. Supposing the population to advance in the same *ratio* for the next five years, there will be during that period *one hundred and twenty thousand* new inhabitants. The rule adopted by the Water Commissioners, in making their estimates, was to calculate 9-5 persons for every lot of 20 by 70 feet. As the city advances, the ordinary size of lots is enlarged, and many new houses will require more than one lot. It would probably be fair to suppose that in the present 12th Ward, lots will be at least 25 by 100 feet, and that therefore 12,630 lots will be required for the occupation of 120,000 persons; that is to say, of the next five years' increase.—Not only will these be wanted, but, at least, 3000 more for churches, public squares and edifices, including reservations for receiving reservoirs, coal and lumber yards, &c. &c. It is also to be borne in mind, that, owing to the disputed titles, and the desire of proprietors to take advantage of the enhancement growing out of their neighbors' improvements, a large amount of lots are for years, kept out of the market for all building purposes. There are between 23d and 57th streets, the 1st and 10th avenues, only 18,836* lots, which will exceed the additional number required for the next five years, including the computed provision for public purposes, by scarcely more than 3000 lots. It is, therefore, reasonable to conclude that, even if our commercial prosperity does not advance at an accelerated rate, the neighborhood of 57th street will, in five years, be more densely populated than that of 23d street (where the prices, according to locality, range from $1500 to $3000) now is.

What arrangements are made to meet the wants of this new population? The graduation of lots is not legally established above 33d street, and even the adoption of the plans, which have passed one Board, would be but a very partial provision for the growing wants of the city. Some even of the streets below 23d street, and most of those above that line, are as yet unopened by law.—Should the corporation now order, as proposed, all streets below 42d street to be opened, judging from the time consumed by the Wooster street and other Commissions, years must elapse, according to the present system, before any thing effectual is done. In many cases, even when the dilatory action of the commissioners has been overcome, no progress has been made towards giv-

* In this calculation, allowance is made for intermediate avenues between the 3d and 4th. 4th and 5th, and 5th and 6th Avenues, two of which have already been partially established by law.

ing a practical operation to the legal proceedings. Thus, in May, 1833, Union Place was opened by law, and assessments paid by individuals to the amount of a quarter of a million of dollars, yet it was not till the autumn of 1834 that any provision was made by the public, for enclosing and embellishing the square; and though the importunities of individuals have at last been so far successful, as to induce contracts for the necessary coping, &c., to be entered into, there is no prospect that any thing effectual will be done, to point out where the square is, till three years have elapsed from the time that the assessments were actually levied. Even when contracts are formally made, their execution, as in the case of 14th st., and of the paving of Union Place, is allowed to be delayed for months with impunity. It may, indeed, be well for landholders to inquire, whether it is not the duty of the Street Commissioner to impose the stipulated penalty on the contractors, and thus diminish, *pro tanto*, the tax to be levied on the parties liable to be assessed for the improvements, and who are the real sufferers by the delay.

Again: the convenience of the people of Yorkville, and of a large adjacent population, who were obliged to go a mile and a half to a dock at the foot of 54th street, in order to obtain their fuel and other supplies furnished by water, led, several years ago, to the opening of 79th street to the East River. Yet, although the assessments on the adjacent property have been long since paid, there is nothing even now to, distinguish that street or road from the neighboring fields.

Let any man visit Brooklyn, or Williamsburgh, (to say nothing of Boston or Philadelphia,) and compare the works there going on, with the perfect inactivity everywhere manifested on this island. The few laborers who are employed, seem to be engaged almost exclusively on the old roads, where their work is in a great measure useless, inasmuch as these irregular lanes are unknown to the legal map of the city, and must be closed on the opening of the Avenues. If complaint is made to the public administrators, by citizens whose whole fortunes are staked on the prosperity of this great commercial emporium, the only reply which is vouchsafed is, that "Brooklyn and Williamsburgh pay higher wages than we do, and therefore take off all the hands." It is obvious that if wages have risen, we must pay as others do, and no one can regret that every class of citizens, should participate in the exuberance of our prosperity. It is infinitely better for the owner of property, by whom in most cases the expense of public improvements is exclusively borne, to contribute a little more than formerly, and have the work promptly done, than it would be to have the streets in front of his lots gratuitously graduated and paved, half a dozen years hence. To the prosperity of the city the difference is incalculable.

Much has been said, during the last two or three years, in the Common Council, by the representatives of the upper wards, as to the importance of placing the Custom-house in a more central position, and against increasing the facilities of communication with Brooklyn. The writer of these remarks has always believed that in the great commercial emporium of the United States, provision should be made for the office of government, on a scale of magnificence commensurate with the revenue received here, and the future, as well as present, business of New-York. He has, also, been of opinion, that, while the people of the opposite shores have their places of business within our corporate limits, and derive from this city their means of living, they should be made to contribute proportionably to those expenses, which are incident to the seaport, by which they are sustained.—But so far as regards the bearing of these matters on the prosperity of the city, or of the upper wards in particular, they are insignificant in the extreme, compared with the importance of giving efficiency to the Street Commissioner's department. Where are the lots on this island, the graduation of which is settled, and which are susceptible of immediate occupation, that are within the reach of men of small means, and who wish to put up houses for their own accommodation? Scarcely a lot, on the streets opened by law, and within the range of graduation, can be purchased for less than $1,500 or $2,000. Hence, by our own acts, a large portion of our industrious population are driven to the opposite shores, and New York is deprived of citizens, whose future accumulations, though deduced from our unrivalled position, will never contribute to the alleviation of our city taxation, or to the augmentation of the property of those, on whom falls exclusively the burthen of sustaining the commercial emporium.

It is not intended by any thing here said, to derogate from the merits of the present Street Commissioner, who, it is understood, is about to retire from an office, for which he undoubtebly possesses eminent qualifications. But, views of policy and a system of organization, which would suit a town of 60,000 inhabitants, are scarcely adapted to a city of 300,000; and if the officers of the Corporation have not kept pace with the advance of our city and country, they have only erred in common with most of the men of the last century. The time, however, has arrived, when it is necessary for our municipal authorities to arouse from their lethargy, or to acknowledge as sober realities, what we have been accustomed to regard as the visionary dreams of our neighbors—that "the sceptre has already departed from Judah," and New York become a suburb of Brooklyn.

A New Yorker.

There is no species of stock of greater importance to the agricultural interest than the hog. His flesh is the most important item in animal food; he is far more prolific than any other large *domestic animal*; he arrives at maturity in *less* time than any other, except the sheep; with half the expense, in proportion to his value; and is much less liable to disease, indeed he can scarcely be considered liable at all. And if we cannot ride him as we do the horse, milk him like the cow, or wear his clothing as we do that of the sheep, still every part of him is valuable; and the short period of his life returns us the pay for his keeping at shorter credit than any other large domestic animal. And yet there is no other animal so completely neglected. In many

parts of the country, a stranger to our customs would suppose, from the treatment they receive, that they were wild animals, and that the people were at considerable expense to maintain dogs, not merely to guard against them, but to worry and destroy them. To any person of a cultivated mind, and who knows the value of the swine, it would be difficult to tell which feeling would be strongest, disgust to see the lean, raw-boned, slab-sided, and long-legged specimens, with long lop ears, which infest our streets, seeking something to keep them from starving; or abhorrence of the cruelty they suffer, in having their ears torn from their heads, by dogs trained to the business; and from whose teeth they are scarcely ever a moment secure.

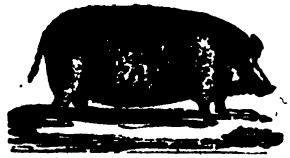
I cannot help thinking the man, who sets the example of reforming this horrid neglect and ill treatment of so valuable an animal, not only by improving all its improveable points, and thereby greatly enhancing its value, but by so doing, rescuing the poor suffering animal from a state of incessant torment during the short period it is permitted to live, deserves at least the thanks of every person, who loves profit and good eating, or who hates cruelty.

Having been long and deeply impressed with such a view of the subject, it has given me extreme pleasure to examine Mr. Bement's pigs, referred to in the following communication, as I think he has arrived at, or very near, the *ne plus ultra* of improvement. Their form is improved in every point. They are small eaters, their growth is rapid, and their appearance shows that their pork must be delicious. I am confident no agriculturist, who has any pretensions to common sense, could see them without being anxious to obtain the breed.

S. Blydenburgh.

[From the Cultivator.]

Improved China Hogs.—Mr. Buel, Sir: Having had frequent applications, by letter, for a description of my *improved* breed of China hogs, I know of no better method of conveying a correct idea, unless by personal inspection, than by a likeness, which I have procured, and accompanies this.



The drawing was taken from a young sow, 9 months old, when in high condition.

This superior breed of swine, as I have observed in a former communication, was first introduced here by the late Christopher Dunn, Esq. Some ten or twelve years since, when passing through Princeton or New-Brunswick, N. J., in the stage, his sagacious eye was attracted by a beautiful sow, with her litter of pigs, running in the street. Delighted with their appearance, he was determined to possess some of them if possible. He accordingly applied to the driver of the stage to procure a pair of them for him. As an inducement, and to insure success, he offered him the liberal price of twenty dollars, for a male and female, although only eight weeks old, on their delivery to a certain house in New-York. They were of course procured and delivered, and from these two have sprung my "*Improved China Hogs.*"

Their color is various, some white, black and white spotted, and others blue and white. They are longer in body than the pure China breed. Upright or mouse-eared, small head and legs, broad on the back, round bodied, and hams well let down. Skin thin —flesh delicate and fine flavored.

They are easy keepers, and of course small consumers, quiet and peaceable in disposition, seldom roaming or committing depradations; keep in good condition on grass only.

They are not remarkable for size, seldom attaining more than 200 to 250 pounds, although instances have occurred where they have been made to reach 350! Therefore, they cannot, in their pure state, be called the "farmer's hog," but their great value is in crossing with the common hog of the country. A very good hog may be obtained by a cross with your *land shads*,—your long legged, long nosed, big-boned, thin backed, slab-sided, hungry, ravenous, roaming tormentors, that will run squeaking about the yard with an ear of corn in their mouths.

To give you some idea in what estimation they are held by persons who have procured them of me, I have taken the liberty of making the following extracts from some of their letters.

"My Chinas, the true *Bement* breed, exceed all praise; you never saw their equals. I have a young boar in the pen, nine months old, that I will show against the United

States, out of the boar and sow I had of you, both of which I still keep. Nothing can compare with them in this country, and I honestly assure you, I never saw their equals any where, for all needful qualities in the hog."

"Dear sir—I have the satisfaction of saying to you, that I got my little Berkshire and China home in good order, and doing finely, and are much admired by every person who sees them. Should I meet with success in rearing from this pair, shall not be able to furnish any thing like the quantity spoken for."

In another letter a valuable correspondent says—"The hogs I had of you have done admirably, and I am getting a fine stock of them; but on the whole, I like the full bred improved China better than the cross, and I am getting back into the pure blood. The young sows, of which I have three from the white (Hosack) boar you had, have had pigs from the old boar, but they are not true enough in blood, appearance, and shape, to suit me; whereas the mother, who is the true China, brings the pigs from the old boar, both in color, shape, size and every thing, as if they were cast in the same mould,—and that is what I like,—uniformity of appearance, even in hogs, and this boar, let me tell you, has the admiration of all who have seen him, as the best and most perfect *hog* in the country. These hogs, 'tis true, are not large, they are indeed rather small; but they are the easiest kept of any according to their size, that I ever saw, and so far as I have yet seen, I prefer them, even to the Bedfords, or any I know. The Bedfords are good, but they are too heavy headed, long legged, and great eaters, to suit me altogether. The quiet, peaceable dispositions of the Chinas, like that of the short horn cattle, is a great item, I assure you, in a farmer's account."

I might fill a page with similar extracts, but I think it unnecessary, for I shall not be able to supply all my orders until next spring.

In the next No. I propose to furnish you with a portrait of one of the Berkshire breed, of which I am now in possession, imported by S. Hawes, in 1832.

C. N. Bement.

Albany, Sept. 1, 1835.

[From the Cultivator.]

On the Utility and Best Method of Cooking Food for Domestic Animals.—This subject has engaged the attention of practical men in Europe and in this country for many years, and it is a branch of rural economy at all times worthy the careful investigation of the farmer. The Highland Society of Scotland have, in a particular manner, directed the public attention to the comparative advantages of feeding farm-stock with prepared or unprepared food, and have, by liberal premiums, induced numerous experiments to be accurately made, and elicited much valuable information. The conclusions which have been drawn from these and other experiments, seem to be,—

1. That a great saving, some say one half or more, is effected by cutting the *dry* fodder for horses and neat cattle, and feeding it with their provender or grain, in two or three daily messes, in mangers. Not that the food is thereby enhanced in its inherent properties, but that given in this way it all tells—is all consumed, all digested, all converted into nutriment. There is comparatively none wasted, or voided, without having benefitted the animal. In the ordinary mode of feeding in racks, yards, and in open fields at stacks, it is well known that much is lost, from the difficulty of masticating uncut hay, straw and stalks, and from its being trodden under the feet of animals and spoilt. Much labor is besides saved to the animal, as cut food requires less mastication, and the animal enjoys a longer period of rest.

2. That grain and pulse, as cattle food, is enhanced in value by being ground or bruised before it is fed out, so much as to warrant the expense of sending it to mill, and the deduction of toll. Indian corn, oats, rye, and other grain, given to farm animals in a dry, unbrokrn state, it must have been observed by every one, particularly when the animal is high fed, are often voided in a half or wholly undigested state, and are virtually lost. This does not happen when the grain has been ground.

3. That although roots, as ruta baga, mangel wurzel and potatoes, are improved as fattening materials for neat cattle, by cooking, the advantages hardly counterbalance the extra expense of labor and fuel.

4. That for working horses, cooking the roots we have enumerated, and feeding them with cut hay and straw, is of manifest advantage; and that thus fed, they supersede the necessity of grain.

5. That in fattening hogs, there is decided economy in grinding and cooking the food. The experiments upon this subject are many and conclusive. Some estimate the saving at one half the quantity of food. Taking into account the various materials on a farm, which may thus be turned to account, we are satisfied that one half the cost of making pork may in this way be saved. Swine are voracious animals, and will eat more than their stomachs can digest, unless assisted by the cooking process. There are upon the farm many refuse matters, as

pumpkins, squashes, small potatoes, early and defective apples and apple pomace, which are of little value, except as hog food, but which, if well husbanded, cooked and mixed with ground provender, contribute essentially to cheapen our pork. It has been questioned whether the articles we have enumerated are nutritive to pigs, when given in their raw state; while all admit, who have made the experiment, that they are highly so when cooked. Cooking undoubtedly adds to their nutritive properties, as it does to the nutritive properties of Indian meal.

Before we offer our views of the most economical mode of cooking food for hogs, and of the apparatus to be employed, we beg leave to submit the plan of a hog pen or piggery, which, with some modifications, is the model of one we examined at the Shaker village in Niskeuna.

Fig. 1.

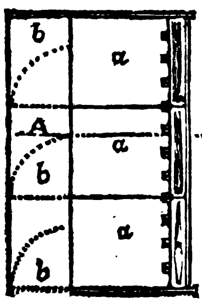


Fig. 1, exhibits a ground plan of the building, showing a gangway in the centre, with a range of pens on each side. The breadth is 26 feet, and the length may be adapted to the convenience of the builder. The pens are six feet broad and ten feet deep, with a cross partition four feet from the rear, and a four feet door, which is used to close the passage between the front department, (*a*) and the department *b*, or to extend the partition between the pens. The different uses of the doors are shown on the two sides in the cut. The pens are calculated for four hogs each, and the section here exhibited will therefore accommadate 24. When the pens require to be cleaned, the doors are shut into the cross partitions, as at A, so that the rear presents an uninterrupted passage, the hogs being confined in *a a*; and as soon as the pens are cleaned, these doors are thrown back as at B. The troughs are embraced in the gangway.

Fig. 2, shows a cross section along the dotted line A B. The partitions are three and a half feet high, the posts eleven feet, giving seven feet to the basement, and four to the upper story, below the roof. The position of the feeding troughs is here shown. They are provided with lids, hung with stout hinges above, and may be let down so as to exclude the hogs from the troughs while they are being cleaned or replenished with food, or raised up, at pleasure, as shown in this section. Each lid is provided with an iron bolt, (fig. 4,) which works in staples, and confines the lid in the position required. This section also shows the slope of the floor in *b b*, so constructed that the urine may drain off. The dotted lines represent the size of the building, when, instead of the apartment *b b*, it is wished to let the hogs run in an open yard. For small farmeries, a single range of pens and the gangway may suffice. The loft serves as a store room for hog food, &c.

Fig. 2.

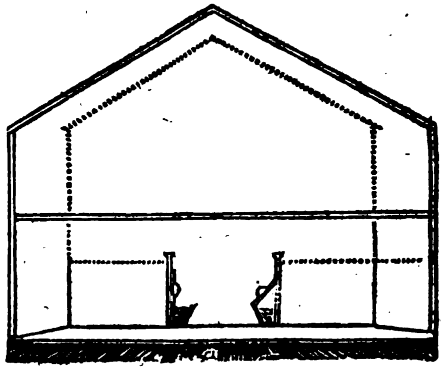


Fig 3

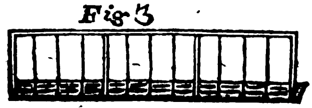


Fig 4

Fig. 3, is a section along C D, showing the studs that prevent the interference of the hogs while eating.

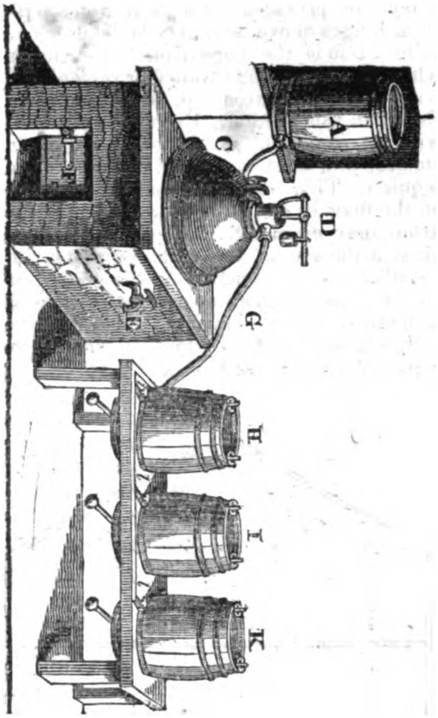
The boiling or steaming room is in one end of the building, and communicates with the passage and the loft.

The peculiarities, or rather the advantages of this piggery, consist in the facility which is afforded of cleaning the pens and the troughs, and of depositing the food in the latter, without being incommoded by the hogs, and in preventing the hogs worrying each other.

We shall now exhibit the model of a steaming apparatus, calculated for a large establishment. We have shown the plan to an intelligent master in one of our furnaces, who estimates the cost of boiler, pipes, and cocks, at $50.

"A is a barrel or other vessel for containing water and supplying it to the boiler C. D is a safety valve. At the upper part of

Fig. 3.



the boiler at C are placed two tubes, with stop cocks. One of these tubes terminates near the bottom of the boiler. Upon the stop cock being turned, water should always issue from this tube. When, therefore, steam issues from it, and not water, this indicates that the water is too much boiled away, and consequently that there is a deficiency of water in the boiler. The other tube terminates within the boiler, near the top. Upon the stop cock being turned, therefore, steam ought always to issue forth. But should water in place of steam come out, then it will appear that the boiler is too full of water. In this manner the attendant, by turning either stop cock, ascertains whether there is a deficiency or excess of water in the boiler. The quantity of water could indeed be regulated by other means; but that described will be found sufficient in practice. F is the furnace, and E is a pipe with a stop cock communicating with the boiler. When it is wished to obtain hot water, it is obtained by this pipe. A pipe G communicates with the barrels H, I, K, and conveys the steam to them; and in these is placed the food to be steamed. By means of the stop cocks *l*, *l*, *l*, the communication can be cut off with any of the barrels, so that the steam may be admitted to one barrel or two barrels, or three, as may be wished. The barrels in the figure are three, but the number may be extended. Each barrel has a moveable lid, which is kept down by screws, and a sliding board below, by which the food, when ready, is withdrawn. The barrels are raised on a frame, so that a wheel barrow or vat may be placed below, and the food at once emptied into it."

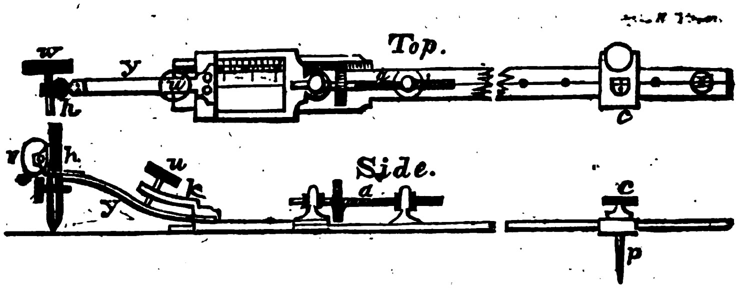
"By means of an apparatus of this kind, roots and other parts of plants may be steamed in a convenient and economical manner."

The relative advantages of steaming and boiling will very much depend, we suspect, on the extent of the establishment. We have tried both, though our steamer was imperfect; and have come to the conclusion, that when the number of hogs to be supplied does not exceed 15 or 20, boiling is preferable,—as with a good boiler, of the capacity of 30 gallons, from 12 to 16 barrels of food may be easily cooked in a day. But much depends on the judicious setting of the boiler, so that it may receive the whole advantage of the fire. For this purpose the brick work should be made to conform to the shape of the kettle, leaving a space of three or four inches between them, until it reaches nearly the top of the kettle, when a tier of brick set edgeways is projected for the flange of the boiler to rest upon; and the bottom of the fire flue should be above the bottom of the kettle, or about parallel with the commencement of the slope which rounds its bottom. By this means, the flame is thrown upon the sides and bottom, and in a manner that the whole boiler is collapsed with it on its passage to the smoke flue; and the brick work being heated constantly refracts back its heat upon the boiler. A tight cover should be laid over the cooking food, to prevent the free escape of the steam, by partially confining which, the cooking process is greatly facilitated.

There should be appended to the hog house an open yard, for straw, litter, weeds, &c., which the hogs, during summer, will work into manure, and into which the dung is thrown from the pen.

Hogs are subject to various diseases, particularly if shut up in a close pen, during the time of fattening, which are often suddenly fatal. Prevention is here easier than cure; and many farmers prefer giving their hogs yard room, where they can root in the earth, which is deemed a preventive. Others give them occasionally rotten wood, charcoal, sulphur, antimony or madder, all which are considered as aperients, cleansers or alteratives, and consequently as conducing to health. Salt is all important, and should be habitually blended with their cooked food.

TRAUTWINE'S BEAM COMPASS.



[From the Journal of the Franklin Institute.]

Description of a Beam Compass, contrived by JOHN C. TRAUTWINE, *of Philadelphia, Architect and Engineer.*

TO THE COMMITTEE ON PUBLICATIONS.

Having recently had occasion to draw several maps of railroad surveys, on a large scale, I was at a loss for a beam compass, of a length sufficient for striking the curves, and, in consequence, contrived, for that purpose, the one here described.

Finding it to answer in a very satisfactory manner, and thinking it might, in the absence of a better, be useful to others, I submit it for insertion in the Journal, provided it be considered of sufficient utility.

The instrument consists of a strip of brass, (mine is three and a half feet long, half inch wide, by one-twelfth inch thick,) having its edges rounded, to prevent its catching in any inequalities in the paper, and being divided and numbered into feet and inches, or in any manner that may be preferred.

Precisely in the centre line of the strip, and at each point of division, is carefully drilled a very small circular hole, entirely through the brass, and barely large enough to admit the finest sewing needle. Pains must be taken to drill these holes *precisely vertical.*

At that end of the beam where the numbering of the divisions commences, is a sliding vernier, by which the divisions may be subdivided into hundreths of an inch. This slide is moved along the end of the beam, by means of the screw, *a,* and is furnished with a holder, *h,* into which a pencil, or drawing pen, may be inserted. It has also a screw, *u,* which, by operating on the stiff piece of brass, *k,* above, and the elastic piece, *y,* below, forces the pencil, with any required degree of pressure, against the drawing. The lower piece, *y,* is elastic, that it may, by yielding, allow the pencil to play over any roughness, or knots, that the paper may contain; and is very essential to the drawing of a clear, unbroken line. *c* is a sliding piece of brass, with a point, *p,* and a semicircular hole, *o,* on top, (for seeing the dimensions on the beam.) It will often be found useful for ascertaining the centre of a circle by trial, when it is inconvenient to do so by calculation.

As the size and proportion of the parts of the slide, (particularly of the spring and pen,) are of great importance, and mine are the result of several trials, I have represented them at one-quarter the full size, to enable others to make them with certainty at the first attempt.

The drawing ink should be perfectly clean and free from dust, and of a certain degree of fluidity, which a few trials will point out.

The paper should be brushed with a clean handkerchief, to remove dust, before beginning to draw the curves.

The dimensions above stated I consider sufficient for beams six feet long, which gives a diameter of twelve feet, a size which is very rarely exceeded in neat finished drawings on paper.

For radii less than three feet in length, both the breadth and thickness of the strip may be reduced.

To use the instrument, having first found the centre from which the curve is to be described, drive a fine needle firmly and vertically into it; and over the needle,

place that division hole of the beam which more nearly corresponds with the required radius; after which, bring the pencil *precisely* to the point of beginning of the curve, by means of the screw, *a*; and after giving it a proper degree of pressure on the paper, by turning the screw, *u*, describe the curve by merely pushing the beam over the paper, without any other vertical pressure than what arises from its own weight. When one line is drawn, and the pencil is to be taken back, to commence another, it may be raised from the paper, either by unscrewing *u* a little, or by slightly lifting the whole slide. It will not be necessary to lift the beam off the needle, for the purpose of altering the position of the pencil, for drawing concentric curves, whose difference of radii does not exceed the play of the slide, as that may be done much more readily by the screw, *a*.

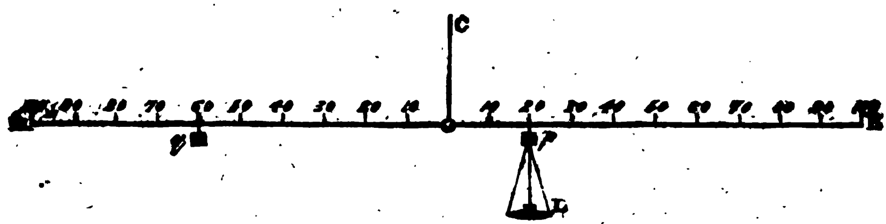
In this manner, any number of curves may be described from one point, without the least enlargement of the centre hole in the paper; a defect to which all other beam compasses I have ever seen, are liable. This is subject to so little spring, or irregularities of any kind, that I have, in the width of *one inch*, described *one hundred* concentric curves, *of seven feet diameter*, precisely equidistant, with as much neatness, accuracy, and clearness, as I could have drawn the same number of small ones, with a pair of common six inch dividers.

The instrument is peculiarly adapted to cases where the centre is on the same plane as the drawing, and where the beam will be supported throughout its entire length, or where it may be upheld by intermediate supports, sufficiently near each other to prevent any degree of sagging; but where it is impossible to support it between the centre and the pencil, it is not by any means to be recommended.

When the curves are finished, the needle may be easily withdrawn, either between the legs of a pair of common dividers, or between the blade and back of a penknife. A hole, *x*, should be made in the beam, for hanging it up.

These beams are kept ready made, for sale, by Mr. William J. Young, mathematical instrument maker, of this city.

MECHANICAL ARITHMETIC.



To the Editor of the Mechanics' Magazine:

Sir,—Permit me to lay before the readers of your Magazine, through its medium, a very curious way to perform the four principal rules of Arithmetic, viz. Addition, Substraction, Multiplication, and Division, by means of a balance. I came across it some time since, and was so much pleased with it, I thought I would send you a copy of it for your Magazine.

The balance may be made either of metal or wood; the arms two feet long each, and divided into one hundred equal parts from the centre each way.

Let any weight represent one or unity; for example, one ounce; one may in the same manner make use of the tenth part of an ounce.

Let the number 364 be applied to the balance. I apply 3 oz. to the hundredth division, and one ounce to the sixty-fourth part.

Let the arm of the balance be loaded any how; we determine what number is the value of that action by suspending at the hundredth division of the opposite arm a weight that may be increased sufficiently, by an ounce at a time, until it prevails. Suppose nine ounces will not yet make an equilibrium, but ten ounces

exceeds it; leaving the nine on, by moving one along the arm I seek for the equilibrium, which I find where the ounce comes to 47, so that the action required will be 947 in value.

To perform Addition—Apply the numbers given separately to one arm, and find the value of the action, as above directed, (see 3d sentence,) on the other arm.

Examples—34, 54, 268, 407, 45, 65, is to be added together.

I add these numbers separately to one arm, and find by trial that 873 is the number required.

Subtraction—From the sum of 567 and 258 take the sum of 489 and 56. First apply the first numbers to one arm, and then the other numbers to the other arm, and seek the value by finding an equilibrium, which I find to be 280, the difference.

Multiplication—Multiply 67 by 15. Hang the number 15 at the 67th division, and find the value as above, which I find to be 1005, the product.

Division—Divide 1005 by 15. Apply the dividend to the balance, and moving the weight 15 along the beam to find an equilibrium, which will be at the 67th division, the quotient.

The *Rule of Three* is performed by multiplication and division; but by this machine one operation is sufficient: 77 : 132 : : 63 being given, a fourth number proportional is required. Apply 138 and two decimal parts to the 63d division, (that is, I apply a weight equal to 132 to the 63d division;) then to the 77th division of the other arm I apply a weight which I change until I have the equilibrium; by thus trying, I find that a weight of 10 ounces and 8 decimal parts is required, which shows the number sought to be 108, the answer.

A B is the balance, whose arms each way are two feet long, and each divided into 100 parts, (see figure); *p g* are brass weights of one ounce each; L is a scale suspended by cords, which, with cords and all, should weigh just one ounce, and other weights as may be needed.

C is a thumb-piece to suspend the balance by, made with a joint like a common scale beam. The above may be properly called *Mechanical Arithmetic*.

S. A.

[From the London Mechanics' Magazine.]

MR. GALT'S SUBSTITUTE FOR STEAM POWER.—The following is an extract of a letter addressed by Mr. Galt, the celebrated novelist, to the Greenock Advertiser:—

"The fatal explosion of the Earl Grey steamer has induced me to try if the principle of my pressure-syphon could be applied to propel vessels; and the result has been so perfectly satisfactory, that I find myself actuated by humanity to make it public, that others may test the experiment, the simplicity of which is not the least of its merits.

"Take a cylinder, and subjoin to the bottom of it, in communication, a pipe—fill the pipe and the cylinder with water—in the cylinder place a piston, as in that of the steam engine—and then with a Bramah's press, and a simple, obvious contrivance, which the process will suggest, force the water up the pipe, the pressure of which will raise the piston. This is the demonstration of the first motion.

"Second—when the piston is raised, open a cock to discharge the water and the piston will descend. This is the demonstration of the second motion, and is as complete as the motion of the piston in the cylinder of the steam engine; and a power as effectual as steam is obtained without risk of explosion, without the cost of fuel, capable of being applied to any purpose in which steam is used, and to an immeasurable extent.

"The preservation of the water may in some cases be useful, and this may be done by a simple contrivance, viz. by making the cock discharge into a conductor, by which the water may be conveyed back at every stroke of the piston to the pipe, at the end of which the Bramah's press acts.

"My condition does not allow me to do more than to solicit that the experiment may be tested. Although no mechanic, I yet believe myself mechanician enough to see the application of the principle."

We give place to the following communication, and would observe that we know nothing more of the subject alluded to than what was contained in the Magazine. We should, however, like to see a specimen of the gun spoken of by our correspondent, Mr. Porter.

To the Editor of the Mechanics' Magazine:

Sir: I have observed, in the June number of the Mechanics' Magazine, (which, having been absent from home, I had not seen till the present week,) an article from the London Mechanics' Magazine, on the

subject of a gun with a revolving breech.—What there may be peculiar in the construction of this gun, I know not, but would inform the public—Mr. Cary in particular, should this meet his eye—that I have had on hand, for seven years, a rifle with a revolving breech, containing nine chambers, which are "brought into position by the single movement of elevating the hammer," and which has been discharged *nine* times in *seven* seconds. When I constructed this gun, I supposed it to have been original, and was about to apply for a Patent; but, learning that guns of similar construction had been in use several years in England, I gave no farther attention to the subject: yet it is here spoken of as something new.* My rifle has a percussion lock, and may be successively discharged without removing the sight from the eye; yet, of course, admitting deliberate aim at each discharge. I shall reconsider the subject, and if I find any evidence that any essential part of my plan is original, I may yet apply for a Patent.

Yours respectfully,

RUFUS PORTER.

Billerica, Mass., Sept. 24th, 1835.

[For the Mechanics' Magazine.]

SIR,—Every new invention, or improvement in an old one, cannot but be of interest to the farmer, when they are such as to lessen the cost of producing grain, and preparing it for market.

With this view of the subject, I take the liberty of introducing to the notice of farmers, "John Marshall's new and valuable improvement in the threshing machine," as it is styled in his patent; I think, however, it is misnamed, and should rather have been called a "screen," or rake. It is intended to, and will, undoubtedly, supersede the use of the common raker, as soon as its operations shall become known to farmers. The following is a description of it, as near as may be given, without the help of a draught.

The screen is formed by taking three ropes, (of about half inch more or less,) double the length required for the length of screen, or distance the straw is intended to be carried, place them parellel to each other, about one foot six inches apart, or more, if the mouth of the machine require it, then pass through the ropes wooden or metallic rods, at such distance from each other, that the space between them shall not exceed half an inch, from end to end of the ropes, then join the ends of the ropes together, and thus an "endless revolving screen" is formed. This screen is made to pass around longitudinal pullies, placed in frames, (a suitable distance apart,) round which it revolves horizontally. To one of these longitudinal pullies, is attached a band wheel, by means of which the screen is attached to the horse power of the threshing machine, and made thereby to revolve with suitable velocity. The machine may be connected with any of the various patent threshing machines in use, and is what has long been with farmers a desideratum, viz.: a simple and cheap manner of separating the straw from the grain, perfectly clean, and conveying the straw to some place adjacent to the threshing machine. The straw with this screen, or raker, may be carried double the distance with half the expense of power, as with the old fashioned rake.

The machine, although simple, is of first rate importance to grain growing farmers. Not a kernel of grain is carried with the straw, which had been separated from the head by the threshing machine.

To all who are desirous of lessening the expense of preparing grain for market, this patent revolving screen, or raker, is confidently recommended.

With a slight alteration, the machine may be made to convey the straw on to a mow, or on to a stack or wagon, thereby saving the expense of *re-handling* by manual labor. UNUS.

[From the Journal of the Franklin Institute.]

Specification of a Patent for a new and improved mode of constructing a Mill Bush, or Spindle Box, for Flour Mills; and also of making and fixing a Ring and Bale in the Eye of the upper Stone. Granted to WARREN P. WING, *of Greenwich, Hempstead county, Massachusetts, February* 20, 1835.

To all whom it may concern, be it known, that I, Warren P. Wing, of Greenwich, in the county of Hampshire, and

State of Massachusetts, have invented certain improvements in the manner of fixing the mill bush, or spindle box, and of constructing a ring and bale to be fixed in the eyes of millstones for the grinding of flour, or other articles; and I do hereby declare that the following is a full and exact description thereof.

I make a box, usually of cast-iron, which I adapt in size to the eye of the stone. For the sake of facility of description, I will give the dimensions of one which I have made, and which, after a fair trial, has been found to answer well in practice.

The box has a top, which top fits on to it, like a snuff-box. It is ten inches in diameter, and five inches in depth, the outer rim being three-fourths of an inch in thickness. The bottom and top are both perforated in the centre, so as to allow the mill spindle to pass through them. This box is to contain three bearing pieces, of block tin, or of any proper mixed metal, which are to be simultaneously forced up against the spindle, and which are in contact with it for about three-fourths of its circumference, the remaining fourth being exposed to the cooling influence of the air. These metal bearings are cast into a follower of cast-iron, a birds-eye view of which resembles the letter H, the outer end of which receives the cam, or eccentric, by which the bearings are to be forced up against the spindle. Cells to receive these followers are formed within the box, by six wings, or cheeks, extending from the top to the bottom, the sides of each of the three cells thus formed being parallel to each other, that the followers may slide readily and truly therein; these wings are, of course, cast with the box. The void space between them admit of the contact of air with the spindle, and one of them is to be used for another purpose, to be presently described.

Between the rim of the box, and the crossbars of each of the followers, the bottom is perforated to allow the passage of round rods of iron, the upper ends of which are formed into cams, or eccentrics, for forcing up the followers, and, for this purpose, extend up through the whole depth of the box. The lower ends of the above named round rods, or spindles, extend down sufficiently below the bed stone to allow of their being acted upon conveniently, as they are all to turn at the same time. The turning them simultaneously may be effected in various ways, but that which I deem the most simple is by attaching each of the spindles to a ring, by means of a jointed crank, so that, when the ring is made to revolve, the followers will all advance at the same time; other modes will occur to any skilful mechanician, and need not, therefore, be specified.

The cover of the box I make somewhat convex; it need not be more than one-fourth of an inch in thickness; besides the perforation in its centre for the spindle, I usually drill, or cast, holes through it, near the inner edge, which I fill with wood, in order to nail the elastic collar thereto.

In order to lubricate, or oil, the spindle, I drill a hole through the bottom of the box, near the periphery, and in one of the angles formed by it, and one of the before named wings, or cheeks, in one of the void spaces. A rod extends down through this hole, in the manner of those attached to the eccentrics, and this carries a leaf within the box, to which a sponge containing oil, or a lump of grease of any suitable kind, may be attached. By turning this rod, the oil, or grease, is brought into contact with the spindle, and lubricates it; and this may be done in a moment, as often as it is found necessary.

My improvement in the bale and ring consists in casting them in one entire piece, in such way that the ring may be let into, and firmly affixed in, the eye of the stone. The bale rises as a semicircle above the ring, or forming such other curve between two opposite points on the diameter of the ring, as shall adapt it to the cock heads of spindles already made. Gains, or notches, are made under the ends of the bale, in the ring, to receive the driver.

What I claim as my invention, is the construction of a spindle box, in which the followers are moved up by eccentrics, or, cams, without the necessity of stopping the mill, and operating substantially in the manner described.

I also claim the arrangement for lubricating, as herein described, and likewise the manner of constructing the ring and bale in one piece, as herein set forth; not, however, intending to confine my-

self to the exact form which I have described, but to vary the same in any manner which I may think proper, whilst the like ends are attached by means substantially the same.

WARREN P. WING.

THE LEXINGTON.—We observe in the London Mechanics' Magazine for August, an account, by "an American," of the *Steamboat Lexington*, which was constructed for, and under the direction of, Capt. VANDERBUILT of this city, rating her at 20 miles per hour, and calling her "the fastest vessel in the world."

This communication called out several others in reply, from which we select the two following, and would ask from Capt. Vanderbuilt, or some one else, a drawing, and such a description as will put the matter at rest, to the satisfaction and credit of all concerned.

Extract from a communication in the London Mechanics' Magazine, signed "James Barstow."

THE AMERICAN "FASTEST VESSEL IN THE WORLD."—Sir: As the account sent you by "an American," of the Steamboat Lexington, and inserted in your journal of Saturday last, does not explain with sufficient clearness the peculiar mode of construction by which she has been enabled to accomplish a degree of speed, hitherto quite unrivalled, and by many deemed utterly unattainable, your readers may be, perhaps, pleased to receive from another American some further particulars on the subject. I have not myself seen the Lexington, but my information respecting her is from a good source.

THE AMERICAN "FASTEST SHIP IN THE WORLD."—Sir: I have read an extract from an American paper, in your last Number, p. 384, giving an account of the trial of the Lexington steamer. I do not quite understand the construction of her deck; and should be glad to receive further information by a sketch in your Magazine. Neither do I comprehend how she could move at the rate of 20 miles an hour, seeing the greatest velocity of her paddle-wheels is but 19.7064 per hour. Perhaps your printer made the error, in stating the diameter of the wheel at 24 feet; surely it should have been 34 or 42 feet: it is in vain to expect an engine with a stroke of 11 feet to make more than 23 per minute; indeed, this speed for the piston is greater by far than is usual in England; so that the speed of the vesse must be attained by increasing the diameter of the wheel.

Under this idea, I do hope your correspondent will write for a more detailed account of the Lexington and her engines, for at present she looks a "trifle slanting-dicular." At the same time, I am ready to acquit your correspondent of any personal intention of misleading your readers.

I am, Sir, yours truly,
W. THOROLD.

Norwich, August, 22, 1835.

Sir: Having read in your valuable journal for August 15th, an account of the "fastest boat in the world," I was induced to look minutely into the description given; and upon comparing the diameter of the wheel with the number of strokes mentioned, I find that the speed of the boat (which is stated to be twenty miles per hour) is two miles an hour faster than the motion of the periphery of the wheel!

Now, Mr. Editor, I take upon myself to say, that no steamer in this country has approached, within some miles, the speed of the diameter of the wheels. The "Diamond," "City of Canterbury," and "Star," now running in the Thames, are no doubt the three fastest boats in Europe; the speed of these boats, is as near as possible, thirteen geographical miles per hour, during which time the periphery of the paddle-wheels moved seventeen miles, travelling four miles per hour faster than the vessel.

Now in the description of the "fastest boat in the world," the diameter of the wheel is given at twenty-four feet, and the speed twenty-one to twenty-three strokes per minute; I have taken the mean of twenty-two strokes per minute; this gives, for the speed of the wheels, eighteen miles per hour, and deducting four miles, as is the case with the three boats before mentioned, will leave fourteen miles per hour; but I wil not allow the Americans even this speed, for two reasons; first, it will be observed that I have founded my previous observations upon three of the fastest, as well, perhaps, as the best boats in this country, both as regards engines and construction, which is the reason that the speed of these boats approaches so near the speed of the wheels; for if the average of thirty boats on the Thames be taken, we shall find that the wheels are often going fifteen miles an hour, while the boats are going only ten miles. Again, the lumber, which is used in American boats, and called steam engines, can never be compared with the engines as now manufactured by our first-rate

makers, either for lightness, safety, or effective force. Taking all these facts into consideration—facts which are well known to scientific men in this country—I think we may allow the American boats a speed approaching thirteen miles an hour, and not more; and this speed is not produced by the eleven-feet stroke or the arched deck and beams, but from the simple fact of her enormous length, as compared with her beams. Vessels of this class may do very well for the large rivers of America, but never would do for sea service, or for the rivers of this country.

As I find in your last number, *another American* has been giving his countrymen a fillip, by endeavoring "to explain more clearly than your former correspondent has done, why this boat has attained this wonderful speed," but which explanation only shows the manner in which she is trussed longitudinally; perhaps he will now have the goodness to explain, why in America steam ships go *faster than their wheels*, while in all other countries they generally go from one third to one fouth slower.

I am, Mr. Editor,
Your obedient servant,
FANQUI.

I send you, Mr. Cultivator, the first of a series of "*Letters from a Father to a Son*," and intend to send you others, should this be thought worthy of a place in your paper, as leisure may permit, or inclination prompt.

PRELIMINARY.

Dear Son,—At no time in life do we stand more in need of parental counsels, or are more likely to be benefitted by them, than at the period when we are throwing off the boy, and are about to assume the cares and responsibilities of manhood. Youth are accustomed to look only upon the bright side of the picture; their anticipations are sanguine; their hopes ardent; and they need to be brought often to consider the sober realities of life, to check their unreasonable aspirations. They see not the sands and breakers which begird the ways of life, and upon which very many are early shipwrecked. They need the experienced pilot. Having served in this capacity for a score or two of years, in the school of experience, where all *may* learn, though all *do not* learn to profit, and being deeply interested in your future welfare, I propose to make over, for your use, some of the lessons which I have been taught in the school where yet you are but a noviciate. They constitute capital, if put to good use, and will be sure to make good returns, in the multiplied enjoyments of life. These will be given as they occur, without regard to arrangement.

Learn early to depend on yourself. Your physical and intellectual powers must be your main dependence for fame and fortune. The ground has been fitted for the seed. Your hands have been taught to labor; your mind to reflect. You must be the husbandman: you must sow the seed and nurture the plants; and the reward of the harvest will depend upon your personal diligence and good management. If you sow tares you cannot reap wheat; if you sow idleness you *will* reap poverty; for however abundant the parental bequest, few can retain wealth who have never been accustomed to earn it.

Beware of extremes—the *two* often meet; and by following the one too far, we often insensibly slide into the other. Thus prudence may run into parsimony; patriotism into peculation; self-respect into pride; and temperance in our habits into intemperance in our partialities, prejudices and passions. While you claim and exercise, as the high prerogatives of a freeman, the free expression of your political and religious opinions, and the right of disposing of your time and property in any way, that shall not infringe upon the rights of others, nor compromit the peace and good order of society, forget not to respect the same rights in your neighbor, whom education or association may have imbued with opinions differing from your own. Reform others by your example: for you can never make a sincere proselyte, in religion, politics or morals, or even in the arts of labor, by *coercion*. You may compel men to become hypocrites, sycophants, and servile imitators, but you do it at the expense of the best feelings that dignify our nature—at the expense of piety, patriotism and self-respect. Be moderate in all things—in your pleasures as well as in your toils—in your opinions and in your passions. Past experience should teach you, that your opinions may honestly change; and however long you may have cherished wrong ones, or obstinately defended them, to renounce error, when palpable, will reflect lustre upon your character. As it is human to err, so it is magnanimous to confess and renounce one's faults.

Intermeddle not officiously in the affairs of others. Your own concerns will demand all your care. Those who busy themselves with other people's business, seldom do justice to their own. Seek for enjoyments in the domestic circle, and make home agreeable to all around you. This is your duty as well as interest. Seek rather to be good than great; for few *can* be great, though all *may be* good; and count the ap-

probation of your own conscience, above the applause of the multitude. Act in secret as you would in public—as though your motives were scanned by those around you — and you will seldom do wrong. Adieu.—[Cultivator.]

APPRENTICES.—The following statement from the Wiscasset Intelligencer, shows the duty of apprentices, and the liability of those who entice them from their proper place of business.

A case was tried in this town, in the Supreme Court, which is of considerable importance to masters and apprentices. The action was brought by the plantiff against the defendant for enticing away and employing an indented apprintice—which was clearly proved. The judge, in charging the jury, stated clearly and eloquently the law on this subject, and the necessity to society of apprentices being steady and faithful to their masters, and that the latter should discountenance every encouragement of apprentices being disobedient and refractory, by refusing them employment. We understood the judge to say, that masters were liable for damages, when they employed or harbored runaway apprentices, whether bound or not, if it could be proved they left their employers without good and sufficient cause. The jury in the above case awarded the plantiff a hundred and twenty-five dollars damages.

IF I WAS HE.—If I was a Farmer, I would devote my whole attention to the cultivation of my farm, clothe and feed my servants well, take care of my stock, mend holes in my fences, take a fair price for my produce, and never indulge in idleness and dissipation.

If I was a lawyer, I would not charge a poor man five dollars for a few words of advice.

If I was a physician, I could not have the conscience to charge as much as they do for feeling the pulse, extracting a tooth, taking a little blood, or administering a dose of calomel and jalep.

If I was a merchant, I would have an established price for my goods, and not undersell or injure my neighbors; I would sell at a moderate profit, giving good weight and measure, and deal as honestly as possible.

If I was a mechanic, I would apply myself industriously to my business, take care of my family, refrain from visiting taverns and grogshops; and when I promised a man to have his work done by a certain time, I would endeavor to be punctual.

If I was a young buck, I would not cut as many ridiculous capers as some do—playing with watch chains, flourishing with their rattans; stamping on the pavements with their high heeled boots, [probably not paid for,] and making remarks on plain and worthy people. They render themselves contemptible in the eyes of the sensible and unassuming.

If I was a young lady, I would not be seen spinning street yarn every day, ogling this young fellow, nodding at another, and giving sweet smiles to a third—sometimes having three holes in one stocking and two in the other.

If I was an old bachelor, I would make every exertion in my power to get married, and if I failed I would buy a rope and hang myself.

And finally, Mr. Printer, if I was one of your useful and respectable *profession, I*—would never trust my paper in a lawyer's hands, and never refuse publishing a piece like this.

N. B.—If I was a subscriber to a newspaper, more particularly such a valuable newspaper as you publish, I would pay for it like an honest man. If I was not a subscriber, I would subscribe for it immediately, and to save trouble comply with the terms.—[Maine Farmer.]

DURABLE WHITEWASH.—I am enabled to certify the efficacy of marine salt in fixing whitewash made of lime. In the year 1795, when I was director of the naval artillery at the port of Toulon, I was commissioned to ascertain the utility of a method proposed by the master painter of that port, M. Maquilan, for whitewashing the ships between deck, and likewise their holds, in a durable manner, by means of lime. Our report was in favor of this process, which consists in saturating water in which the lime is slacked with muriate of soda, (common *salt.*) The whitewash produced by it is very permanent, does not crack, nor come off upon one's hands or clothes. The experiment was made only on wood. It appears from M. St. Bernarde's account, that it succeeded equally well on walls.—[Annales des Arts et Manufactures.]

SOUTH FERRY.—The Long Island Star says—We are gratified at being able to inform the public, that two boats, each upwards of 150 feet in length, are now being built for the South Ferry, between Atlantic-street and New York. The Jamaica Railroad which terminates at this ferry, will soon be completed.

MECHANICS' MAGAZINE,

AND

REGISTER OF INVENTIONS AND IMPROVEMENTS.

VOLUME VI.] DECEMBER, 1835. [NUMBER 6.

TO THE PATRONS OF THE MECHANICS' MAGAZINE.—With this number, I close the *third* year, or 6th volume, of the work.

In thus bringing to a close, in that department devoted to my mechanical friends, the labors of another year, it will not, I trust, be deemed improper for me to refer to the past, by way of apology for the numerous deficiencies, with which, as the conductor of the Magazine, I may be justly charged; and at the same time to speak of my intentions, in relation to its course; and of my hopes and expectations for the future.

When I first proposed to publish this Magazine, now three years since, I was induced to believe, from the *absence* of such a work, and the frequent inquiries for one, that if undertaken with spirit, and carried on judiciously, by any person who would call to his aid those who were competent to profit by the numerous and ingenious inventions, improvements, and suggestions of the day, and to select from the mass of useful materials, accumulated and accumulating, in this country, which ought to, and would be, (but for the want of a cheap and popular periodical, through the columns of which it might be disseminated far and wide,) in the hands of every artizan, mechanic and laboring man in the country—that, notwithstanding the heavy expense of publication, it would eventually become, not only a very useful, but also a profitable periodical. With this view of the subject, I embarked in the work, and commenced its publication, without a single subscriber; and, notwithstanding my numerous other engagements, by very great exertion I have continued it to the close of the *third year*—a period, during which, if at all, it would seem that a correct opinion should be formed as to its *utility*, as well as to the prospect of its meeting with sufficient patronage to warrant its continuance.

As to the *first*, its readers are probably better qualified, than its publisher and proprietor, to judge; and to them, therefore, I leave *that* question for decision; and I trust that they will answer in the affirmative, when I assure them that it will be continued, *although it has not thus far paid its expenses*, as it has been a separate and distinct work, devoted with fidelity and increased zeal to those whose title it bears.

It is true, that heretofore I have not been able, from the nature of *previous* engagements, to devote as much time to its columns as I desired, or as I ought to have done; but from this time I am relieved from the most arduous, and laborious part of my duties, the care of the *business* department of a *daily and semi-weekly newspaper*; and I shall, therefore, be able to give the Magazine more of my personal attention, and from its increased circulation, to furnish more valuable matter for its columns, and thereby to render it more interesting, and useful to its readers.

As an evidence of this determination, I now promise to republish, in the course of the ensuing year, NICHOLSON'S Treatise on ARCHITECTURE, which, of itself, costs $3, or as much as a year's subscription to the Magazine, and which will be found "*a complete development of the methods of drawing and working the five orders*, which may be said to be the foundation of the art of building." There are in this treatise, *forty-one* octavo sized plates, accompanied by concise, yet clear and explict, rules and directions for the following, among *many other* kinds of work, viz. to describe the several kinds of mouldings; to diminish the shafts of columns; to draw the flutes of do.; to draw the flutes and fillets on the shaft of a column, or pilaster; to glue up the shaft of a column; to draw the Tuscan,

or any other order; exhibiting representations of columns of the different orders, as taken from ancient temples of Greece and Rome.

In order, however, to give a better idea of the value of this Treatise, the preface is copied entire—and the fact that it has gone through *six editions* in England, and now sells, in this city, for *three* dollars a copy, containing less than 100 pages—it will be inferred, that it is likely to be of some utility, to, at least, a portion of the readers of this Magazine. In addition to this, will be given plain and explicit directions for building, from the Encyclopedia Britanica. I shall, also, endeavor to give a short treatise, or catechism, on *Phrenology*, with a plate.

The Students Instructor in Drawing and Working the Five Orders of Architecture.

PREFACE.—The following Treatise will be found particularly useful to Students in Architecture. It contains a complete development of the methods of drawing and working the five orders, which may be said to be the foundation, the very A B C of the art of building: as from these, with their several proportions and variations, arises all that is great, elegant, or harmonious in the noblest structure; wherefore I most earnestly recommend to the student, to obtain a thorough knowledge of every order, its parts, proportions, and entire figure, as being absolutely necessary to ALL who aspire to eminence in this profession.

To this purpose the following work is well adapted, and gives in the most detailed and accurate manner, examples of the five orders, their proportions and enrichments, according to the present taste; which are so completely explained by the lines, and the measurement on the plates, that a little attention will enable every person readily to comprehend the proportion, use, and situation of each member: and also the several methods adopted in calculating the parts, and for setting them off on rods for practice, to any scale.—The manner of drawing them on paper is fully explained, and I must here advise the student to make a diligent practice of drawing the outlines to a large scale, so hat the measures may apply with accuracy, before he proceeds to finish in shading; by so doing, he will acquire a facility of manner, and an accuracy of eye in judging of the beauties of proportion, which will ever be of essential use to him.

The explanation of the Tuscan order is given very full, and as the same methods apply to each of the other orders, they are not repeated. It is scarcely necessary to observe, the height of the several columns is given according to the most esteemed masters; nevertheless they may with much propriety be varied, to suit particular purposes or situations.

The method of describing quirked mouldings is new and easy, for practice, for any swell. I have shown a new method for striking the Ionic volute, which will produce that spiral curve with more elegance and regularity in the sweep, than by any other method I have seen.

That important branch of practice, glueing up of colums and capitals, is shewn in a new and accurate manner, easy to be understood. I have also shown new and easy methods for diminishing of columns, and for marking the flutes and fillets on them and on pilasters; which, with various other interesting matters, will, I hope, make the operative parts of the orders better understood, both in theory and in practice, than by any former publication.

P. N.

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PREFACE TO THE THIRD EDITION.—The usefulness of this little volume has been fully proved by the great numbers which have been sold: a new Edition being now called for, I have examined the work throughout, and have made such corrections and additions, as appeared to be necessary to adapt it to *the prevailing* style of architecture: to this purpose I have given a new plate containing a variety of *Modern Mouldings*, also six new ones of *Antique Doric Capitals* and entablatures, with the parts at large and in detail: so that in this small work every member of these specimens of ancient magnificence is equally clear and distinct, as in the large work of the original author; and as I have reduced the proportions to the modular scale, they are more easily put in practice. Upon the whole, it will be found that the Greek Doric which has of late been so much in vogue, is fully explained and elucidated.

I have also given an example of a chaste and noble Ionic Capital; all these are selected from *Stuart's elegant and interesting work on the Antiquities of Athens;* the other new plates are an outline of the Composite Capital for the use of learners, and an antique Ionic Door-case, proper to be drawn from or worked. These additions, on ten new plates, with various corrections in the descriptions, render this edition more complete and useful; and I think there is now nothing wanting to constitute it a complete introduction to the orders of architecture both ancient and modern.

American Cement, or Artificial Stone, or, as it it is more generally at this time known, "Parker's Cement," is an article of great and increasing value to this community.

We recollect being at Syracuse in the summer of 1834, on a visit, where we were introduced to Mr. Obadiah Parker, as an ingenious and intelligent gentleman, who had made some valuable discoveries in the use and application of what is commonly known in that vicinity as *Water Lime;* and on visiting Mr. Parker's residence, in the immediate vicinity of Syracuse, we were shown some beautiful specimens of cisterns for rain water; steps for front doors to dwellings, and for various other purposes, which certainly gave strong evidence of great utility. We were then informed by Mr. P. that he intended to visit this city, with a view of introducing the article as a substitute for the common brick and mortar cistern, and on our return, late in the fall, were informed that he had done so; and that the American Institute had awarded him a *gold medal*, by way of expressing their high approbation of the value of his discovery, or new application.

Upon this, Mr. Parker commenced putting down cisterns in different parts of the city, with a view of showing, by actual test, subject to the frosts of the then coming winter, its value, and superiority, over every other material then in in use for such purposes.

From a numerous list of names and certificates, which we have seen, from gentlemen who were induced to give it a trial, we select the following as sufficient, though we might, if it were necessary, as easily give *hundreds* of others, to establish the fact, that the introduction of this article into general use will prove of almost incalculable benefit and convenience to this community—and that Mr. Parker is truly, and will be ere long justly, acknowledged as a public benefactor.

We merely give, in this place, the names of six gentlemen of this city, who put down cisterns last fall, together with a few others at Catskill, Greene county; and at Syracuse, Onondaga county, New-York; who have either had work done for their own use, or have witnessed that done for others, previous to the opening of the spring of 1835.

By these letters, it will be perceived, that similar results and opinions have followed its use in different and remote parts of the State.

The first is from gentlemen residents of Syracuse, and neighbors of Mr. Parker, who were familiar with his operations; the next from gentlemen residents of the same place, who had tested the utility of those operations; the third is from gentlemen residents of Greene county, who had examined specimens of the work; and the fourth are gentlemen residents of the city of New-York, who are, or may be known, to any one who desires further information.

The following testimony is given by gentlemen of this city, and the works to which they allude were visited by hundreds, who desired to test its utility.

Syracuse Aug. 26, 1835.

We, the undersigned, inhabitants of Syracuse, having examined Mr. Parker's Water Cisterns, are fully satisfied of their usefulness and permanency, and confidently believe that they will be preferred and used by all who become acquainted with them.

Schuyler Strong,	S. Tousley,
M. D. Burnet,	S. W. Cadwell,
Rich'd. S. Corning,	Hiram Judson,
P. Thurber,	M. Williams,
Z. T. Newcomb,	Hiram Putnam,
Z. W. Cogswell,	John White,
J. H. Colvin,	E. F. Wallace,
L. H. Redfield,	M. S. Marsh,
J. C. Woodruff,	Joel Owen,

W. B. Goodfellow, Silas Ames, Rich'd. R. Davis, M. M. White, Henry Davis, Jr., C. L. Lynds, E. Walter, S. S. Forman, Amos P. Granger.

Syracuse, Aug. 26, 1834.

From having my attention frequently called to the new plan of erecting Cement Cisterns, as patented by Mr. Parker, and from a conviction of their decided superiority over any other in use, I was induced (as agent of the Syracuse Company) to employ him to construct one of the largest class, (containing sixty hogsheads) for the Syracuse House, and my expectations have been fully realized. These Cisterns combine, in an eminent degree, great durability, with cheapness of construction, while they preserve the water pure, and are much more easily cleansed than any other now in use.

H. Baldwin.

I hereby certify, that the Water Cistern, erected by Mr. Parker, for the benefit of this house, containing 200 barrels, proves to be a first rate article, and I recommend his mode as superior to any other.

Daniel Comstock.
Syracuse House, 26 Aug. 1834.

Catskill, 12 Feb., 1835.

We, the undersigned, residents of the county of Greene, now in attendance at Court, have, by invitation, visited Mr. O. Parker's establishment in this village, and examined his specimens of Artificial Stone, ranging in age from six months down to four days, and are perfectly satisfied that his Cement is an invaluable article, for all kinds of architecture. Mr. Parker has shown us a Tan Vat, of perfect form, and the end wall of a house ten inches thick, sixteen and a half feet long, and eight feet eight inches high, with a door and two windows, standing firm. This wall has a hard finish, on both sides. From this specimen, we are satisfied, that Mr. Parker can give his walls as smooth a surface as can be made on any wall whatever. He has, also, shown us other specimens of great utility. By his inventions, Mr. Parker is giving to the community one of the most valuable discoveries of the age, and we most cheerfully recommend him to the consideration of all. We omitted to notice a few specimens of marble, made from cement, which are very handsome and smooth.

P. King, Wm. Polley, Henry G. D. Kirshaw, } Judges of the Com. Pleas.
John Lawrence, Sheriff.
Sidney Tuttle, Ex-Sheriff,
W. V. B. Heerlance, Clerk of Greene co.
Orrin Day, President Tanner's Bank,
Henry McKinstry,
Isaac Van Loan,
Rev. David Porter, D. D.,
Rev. Tho. M. Smith,
Rev. J. N. Wyckoff, V. D. M.,
Thos. O. H. Croswel, M. D.,
Abraham Van Vechten,
H. Hill, Jr., C. Hull, Jr.,
Ira Dubois, Wm. Van Bergen,
Elcila Blackman, Alonzo Green,
James L. Elliott.

I had four Cisterns constructed last fall, of cement alone, according to Mr. Parker's patent, neither of which were in the least degree injured or affected by frost, the past severe winter; and I consider them superior to Cisterns of any other kind, being apparently as good, as if cut out of solid rock. I have also examined various other articles of Mr. Parker's work, and consider his inventions, in the use of cement, of vast importance to the public.

Sam'l. Whittemore.
New-York, May 18, 1835.

Having had several pieces of work done in hydraulic cement, according to Mr. Parker's patent, and having seen Cisterns, and other articles composed of the same material, all which I regard as perfect, being far superior to the same kind of work done in brick or stone, laid in mortar, I cheerfully recommend them to the public.

Garrit Gilbert.
New-York, May 16, 1835.

Mr. Obadiah Parker, in the fall of 1834, built four Cisterns, at our houses in Christopher-street, entirely of American cement; that they were exposed to the cold of the winter, which had no perceptible effect upon them whatever, and we consider them to have been tested as to strength, and believe they are much

better calculated to resist frost than brick or stone Cisterns, being entirely composed of one material; and that their capacity to hold water, we consider as beyond doubt. We have seen various models of improvements in the construction of the arch and curb, at No. 107 Amos-street, and from the experience we have had in the article, we should not hesitate to recommend them.

CLINTON GILBERT.
HENRY STOKES.

New-York, May 8th, 1835.

I have had two Cisterns, built by Mr. O. Parker, composed, according to his patent, of hydraulic cement; and give them a decided preference over brick, stone, or any other material heretofore used, and recommend his invention to the public as a valuable discovery for all hydraulic purposes.

GEORGE BOWMAN, Master Mason.

New-York, May 1, 1835.

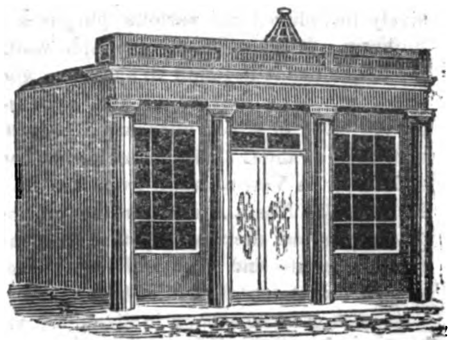
I have examined the hydraulic cement works of Mr. O. Parker, and coincide with the above.

JOHN BOWMAN, Master Mason.

May 1, 1835.

Thus far only had Mr. Parker proceeded at the opening of the spring; yet far enough, as it would seem, to satisfy many gentlemen that he had opened a field of ample dimensions, and one which promised richly to reward those who would diligently cultivate it. A company was formed, and suitable accommodations provided in Amos street, where specimens of various kinds might be prepared for exhibition; and where experiments might be carried on for the purpose of ascertaining and determining the various purposes to which it might be usefully applied—and that they might be at the same time prepared to execute such orders as might be given for cisterns and other purposes. They commenced by putting down several cisterns, vats, cellar-steps, specimens of aqueducts and sewers—and also by erecting a pillar, cisterns and vats above ground, together with numerous other specimens of curbs, arches and necks of cisterns, &c. &c. &c.—which soon attracted attention, and gave the Company more orders than they could execute.

In order to satisfy the community still farther, if it were necessary to do so, they commenced and completed an office for their own use, on the front of their lot in Amos-street—which is a beautiful specimen



of work. It is a small building about 16 by 12 feet on the ground and 12 feet high, having four beautiful columns and pediment, with a door and two windows in front, an *arched roof* entirely of cement, and sky light in the top—thus forming an entire building, including *floor*, *walls*, and *roof*, of one solid piece, and of *imperishable* material; alike proof against fire and water. The only wood to be seen in the structure is in the door, windows and casings of them. We give herewith a view of the building—the original of which may be seen at any time, by any person who will call at 107 Amos-street, in this city—together—if they will take the trouble to inquire for the Superintendant—with numerous and beautiful specimens of other kinds of work in the yard, immediately back of the office.

There is indeed something singular in this material—and in its rapid transition from a *paste, to a solid rock*. It may, when properly prepared, be poured from a vessel, a pail, for instance, into a mould, as you would pour thin porridge; and it will in a few hours become set, or hard, so that the mould may be taken from it, and the article moved from place to place, without injury—yet it may be cut with a knife as readily as cheese, for a short time, although it becomes harder and harder until it is

equal to freestone, *marble*, GRANITE, and finally until fire may be struck from it with a steel as from a flint, whilst it rings sharp and clear on being struck, like porphyry.

It is also capable of resisting intense heat, an important quality which is not possessed by some of our most valuable and fashionable kinds of stone, now much in use in this country; and it must therefore be extensively introduced for various purposes of building. It is also valuable for side-walks, for which use it is found to answer a good purpose; also for drains and sewers—for the latter of which purposes a beautiful specimen of about 2½ feet diameter has been laid down in Vesey-street, from the *Astor Hotel to the North River*, for the purpose of carrying off the wash of that immense establishment—and if it had been necessary, it might doubtless have been made *six feet*, as well as 30 inches in diameter, with perfect safety. Indeed, we see no good reason why an *aqueduct* might not be made of this material, *under ground*, for the purpose of introducing water into this city; and in order always to be sure of a constant supply, there might be *two* of them side by side, of *four* to *six* feet internal diameter, each with a thickness of material of 1½ to 3 feet, as might be deemed necessary—following the surface of the ground—or they might be constructed upon *long levels*, open at the top, and closed only where vallies, or considerable inequalities of the surface are to be passed—thus avoiding the enormous expense of constructing elevated aqueducts, which must otherwise be resorted to; thereby dividing the upper part of the city into two parts, admitting of passages under its arches only.

These, however, are only a few of the numerous uses to which it may be, or in fact, is already appropriated Beautiful specimens of *busts* or statuary have been already made—and it will also come into extensive use for coffins and cemeteries. We have seen specimens of coffins which received a beautiful polish, or any kind of stain, or painting, and gilding that may be desired, with a glass over the face.

A coffin made of this material will be of about the same weight of one of similar size made of solid white oak. It will however have this advantage over one made of wood—the lid being put on with cement, after extracting the air with an air pump, it will not only be air tight, but will grow harder and more solid as time rolls on, preserving its tenant, though not in life, yet in form, as perfect, it is believed, for centuries, as when it was encased in its house of stone.

Time and space fails us to enumerate further the uses of, and benefits to be derived from, this valuable material; a material discovered and known to exist in this country only since the commencement of that vast and noble work, the Erie Canal. We shall, however, often refer to it again as its uses shall become more and more developed.

[For the Mechanics' Magazine.]

SILK AND WORSTED.

From the middle of the last century to the present time, may justly be reckoned as the commencement and progress of a new era, in almost the entire catalogue of the useful arts; or it may even be set down as an incontrovertible truth, that most of those arts date their very birth and existence, within that time. All that existed in practice, or was known of them, before that period, was as mere germs or embryos, from which they have sprung, and are daily springing into real life. Before that time, the arts were conducted on no fixed principles. Every mechanical operation was performed by the joint effect of imitation and habit, as a parrot learns to speak, or a monkey to perform gesticulations. *Science* was to art a mere laughing-stock, and *art* was *looked* upon by *science* as a subject of contempt—utterly unworthy of respectful notice.

But about seventy years ago,

"A change came o'er the spirit of the dream."

About that time, the *soi disant* chemists, whose science had hitherto consisted of whim-wams and opinions, with some isolated facts, which, though important, bore no known analogy with each other, began to discover, in different parts of the world, that these supposed disconnected facts, were the connected links of a chain or

body of science, of infinite importance to the world; and that the workshop of the mechanic, and the field of the agriculturist, were but exemplifications of scientific principles, which, if applied to useful practice, would produce results which ambition had never dreampt of. A Schule, a Priestly, and others, began to suspect that these fragments bore relationship to each other, and a Lavoisure succeeded in putting the puzzle together.

Philosophers, in various quarters, began now to suspect that they could apply the result of their studies to more profitable use than to weaving incoherent systems of hypothetical cobweb. They found that certain facts, which had passed the ordeal of demonstration, would combine together, and form coherent systems, but that they must be thoroughly cleansed from vague hypothesis. They found, by reflection, that some of the useful arts, which had thus far been kept under the guidance of bundles of foolish *arcana*, followed, as a blind man pursues a beaten path, but is instantly lost if he gets out of it, were neither more nor less than illustrations of the principles they had discovered, applied to practice; and that many of those arts, if once properly conducted, afforded openings to sources of immense wealth. Science, from that time, began to assume demonstrative character and systematic form, and art to be conducted on scientific principles.*

The advancement of human knowledge had then began to feel a considerable accelerating impulse, from the invention of *printing;* and it was probably by means of this impulse, that the use of *steam*, as a motive power, and the art, or rather, the principle of *spinning*, by machinery, propelled by inanimate power, were discovered; and these two inventions, aided by the principles of science, may be set down as the pioneers to a field of knowledge in the arts, compared with which, all previous knowledge of those subjects, may be considered as seeds, contrasted with the display of luxuriant vegetation. These discoveries, as they have been applied to, or have called into requisition different branches of the arts, have given new impulse, new forms, and new modes of operation, which, without them, would probably never have been thought of, or believed practicable, had they been proposed. Could the most ingenious mechanic, of 150 years ago, go into a machine shop, or a cotton or woollen manufactory of the present day, he would be lost in amazement, and believe it all to be magic.

But this world of improvements, though more or less apparent in every branch of useful art, has displayed its most wonderful effects, in the various productions of the spindle and the loom; and, in this department, mostly in fabrics from cotton and wool. In linen, little has been effected; and though an immense field is open, circumstances appear disposed to defer occupying it till some future day. In silk, some improvements have been made, in Europe; but, in that also, a wide field is presented.

In the United States, the cotton business is now fairly introduced; and the woollen, except that branch denominated *worsted*. These branches have already opened a source of profitable and respectable employment to a numerous class of our citizens, as machinists and millwrights, who, in consequence of those very gifts of nature, which now render them the ornaments, and their works the boast of society, would otherwise have remained as they were formerly, idlers and drones, and rather despised than respected. But besides these, a still more numerous host are employed by these branches as carders, spinners, power-loom tenders, boarding house keepers, traders, and many others, who are now maintaining themselves in comfortable circumstances, and enriching the nation by their labors; who, but for these branches, would, most of them, now be pining in obscure poverty and wretchedness.

How much it behooves us then, on every principle of patriotism and national policy,

* This was strongly exemplified by Mr. Chaptal, in the process followed in dying the Adrianople, or Turkey red. He found, that out of 23 distinct operations, strictly enjoined in the formula, by which the dye was effected, three only had any effect on the process; the others were mere blind guide-posts, by which they had groped their way, till they had blundered upon the true result, by accident.

as well as pecuniary self-interest, if we can open another field of equal or similar importance, from which to reap such a harvest of prosperity, to lose no time in doing it, but to set about it with energy.

And such is the field now open, and courting our occupancy, as well in the culture and manufacture of silk, which promises equal benefits, as in the business of manufacturing worsted, which, if not an object of equal magnitude, will probably be equally beneficial, as far as it goes. The spirit of the country is now awake to engage in the culture of silk; and we have not only the means, to the most unlimited extent, but we have advantages superior to those which any other nation ever possessed. The business of manufacturing *worsted* will prove a highly important branch, both to the manufacturing and agricultural interest, and the rapid march of improvement, both in the quantity and quality of wool, bids fair to afford a better selection for the purpose than can be found elsewhere.

It is, perhaps, a fair estimate to say that the value of all the property in the United States, except what is exclusively engaged in commerce, is now double what it would have been, without the manufacture of cotton and wool, and the profits of producing the raw materials for both. If this position be true, the *establishment* of silk and worsted will, in the same length of time, produce at least as great an increase.

It is sometimes asked, "Should the United States go with avidity into the production of silk, would not the business be overdone?" To this I would answer: If we take into consideration these facts, which are well established, that the American silk is superior in quality to that of almost any other country; that we have an exhaustless supply of land, peculiarly adapted to the production of silk, at a price scarcely worth taking into the account; that England alone buys raw silk to the annual amount of about $10,000,000—nearly all of which she will purchase of us, because, for the reasons just mentioned, our silk will be the best and cheapest; and also, that our own population, which now consumes, annually, $12,000,000 worth of manufactured silk, is rapidly increasing, and the increase of wealth will, doubtless, cause more silk to be worn in proportion to the numbers; from all these circumstances, I should think there would be about as much danger of overdoing the silk business as of the Hudson River becoming useless by the water all running out.

The business of producing and manufacturing silk is naturally divided into three distinct branches: 1st, rearing and cultivating the mulberry trees; 2d, feeding and attending the worms till the cocoons are finished; 3d, reeling and manufacturing the silk; and though many will unite the two first branches, and some all three, it will be found ultimately that the greatest profit will result from pursuing the branches separately. The agriculturist, in connection with his other concerns, will find the mulberry tree a most profitable article, especially as the most suitable land is such as would be of little value for other crops. The leaves may be sold, like any other produce, to those who rear the silkworms; or if he has a wife and daughters, they may carry on the second branch, and sell their cocoons to the manufacturer. The manufacturing of silk will be, at least, as profitable as of cotton or wool, and perhaps more so; and will open a new and extensive demand for machinery, and give a new impetus to inventive genius, as well as to skilful execution. In illustration of this part of the subject, I will here give the testimony of *Stephen Wilson*, a *silk manufacturer*, taken before a Committee of both Houses of the *British Parliament*, on the subject of the *silk trade*, and *silk manufacture*, in the year 1821.

Mr. Wilson says, "Nearly two millions of raw and thrown silk are annually imported into England; it gives employment to 40,000 hands, in throwing it for the weavers, and their wages are $1,554,000. *Half* a million pounds of soap, and a large proportion of the most costly dyestuffs are consumed, at a farther expense of $1,332,000, and $1,176,600 are paid to winders to prepare it. The number of looms may be taken at 40,000, and the weavers, warpers, me-

chanics, &c., will employ 80,000 more persons, and their wages will amount to $13,120,000. Including infants and dependants, 400,000 mouths will be fed by this manufacture, the amount of which I estimate at $44,400,000."

It would be impossible to set down, with any certainty of correctness, the extent to which the worsted manufacture would be carried; but it would, perhaps, be safe to reckon it the next most important branch, after cotton, silk, and wool.

The worsted business is already commenced at Lowell, that metropolis of useful enterprise, and every true-hearted American must sincerely wish it success. It will probably soon awaken, in the wool-growing community, a spirit of laudable emulation, in producing long and fine wool, a description hitherto of no peculiar value in this country. The machinery in this branch will be nearly the same as that used for spinning cotton; as it is spun on the same principle, only a little varied in the application. The quantity will be a most essential object in the machine making department.

In the production of silk, the agriculturist may raise, from a given number of acres of his poorest and most wornout lands, probably double the value, in mulberry leaves, that he could obtain from twice the number of acres of his best land, in any other crop; and his women and children can harvest it. The women and children, employed in hatching and feeding silkworms, will find an unlimited field of employment, more profitable than any they have ever engaged in. The man of wealth and enterprise will find, in manufacturing it, a safe, profitable, and almost boundless investment for his capital, and if he is a philanthropist, he will have the additional satisfaction of dealing to thousands of his fellow-creatures the sweet reward of industry. In the mechanical department, also, as I have already stated, an immense field will be opened, not only of profitable employment, to the industrious and skilful mechanic, but of liberal encouragement to inventive genius.

From all these considerations, it becomes the imperative duty of all the above named classes, not merely to express their wishes, but actually to exert their utmost power to forward the introduction of these two important branches. Let the agriculturist immediately set about producing mulberry trees, and the wool-grower obtaining long fine wool. Let every woman, who has a moment's leisure, set herself industriously to obtain the means of beginning with a few silkworms, and of providing for their future increase; and let every enterprising mechanic do all in his power to facilitate the introduction of silk and worsted, and they will soon see the commencement of a second distinct era in the progress of American improvements.

ARCHIMEDES.

[For the Mechanics' Magazine.]

Lowell, Mass.—Its Manufactories, &c.

The town of Lowell, in Massachusetts, is about four miles square; and fifteen years ago, contained but a few families, of honest farmers, who obtained subsistence for themselves, by cultivating the barren soil, and by fishing in the adjacent streams. It is situated at the confluence of Concord and Merrimack Rivers, and was formerly called Chelmsford Neck, and originally by the Indians, Wamaset. It contains at present about fifteen thousand inhabitants.

In 1819, Kirk Boot, Esq., a merchant of Boston, discovered its resources, and, in company with several others, purchased the land and water privileges. They were incorporated by the name of the "Proprietors of the Locks and Canals on Merrimack River," and commenced operations by digging a Canal from Merrimack River near Pautucket Falls. This Canal is sixty feet wide, and the depth of water eight feet.

This Company has a capital of $600,000, and employs about 200 workmen in their machine shop.

The first manufacturing company, in respect to age, and amount of capital, is the Merrimack. It has a capital of $1,500,000, and five large brick factories, containing in the whole 26,000 spindles, and 1,000 looms. There are employed in it from three to four hundred males, and from eight to nine hundred females.

1,500,000 lbs. of cotton are used in it annually. It manufactures yearly 6,500,000 yds. of bleached and printed goods. This Company was incorporated in 1825.

The Hamilton Manufacturing Company has a capital of $900,000, three large brick factories containing 16,000 spindles, and 500 looms; employs 700 females, and 200 males. It consumes 3,500 bales of cotton yearly. Twilled goods, cailcoes and fancy articles are manufactured in these factories.

The Appleton Manufacturing Company has a capital of $500,000, two large brick factories, 9,500 spindles, 350 looms, and employs 60 males and 470 females. It uses 1,500,000 lbs. of cotton yearly, and makes about 4,000,000 yards.

The Lowell Manufacturing Company has a capital of $600,000, one factory for cotton goods, containing 4,000 spindles, and 132 looms. It consumes about 1,000,000 lbs. of cotton, and makes 2,184,000 yards per year. This Company has also a carpet factory, where they make 3 or 400 yards per week. It manufactures the Kidderminster and Brussels carpets, and beautiful rugs of various descriptions. They employ 175 males and 200 females, in both mills. Incorporated in 1828.

The Middlesex Manufacturing Company, with a capital of $500,000, has one factory in operation, containing 3000 spindles, 62 cassimere looms, 238 for broadcloths, employs 145 males and 240 females, and consumes 400,000 lbs. wool, and maks 200,000 yards cassimere and broadcloth annually. Incorporated in 1828.

The Suffolk Manufacturing Company has a capital of $450,000. Two brick factories, 10,240 spindles, 352 looms, employs 70 males and 440 females. It makes twilled goods, and uses from 4,160 to 4,680 bales of cotton annually. Incorporated in 1830.

The Tremont Manufacturing Company has a capital of $500,000, two brick factories, with 11,136 spindles and 410 looms. It consumes 170,000 lbs. of cotton, and makes 600,000 yards of cloth annually. It employs about 550 persons. Incorporated in 1830.

The Lawrence Manufacturing Company has a capital of $1,200,000, four large brick mills, 24,000 spindles, and 700 looms. This is perhaps the most elegant building in town. About 1,160 persons are employed in it. Incorporated in 1830.

In addition to the above, there are some important establishments, among which are, the Belvidere Manufacturing Company; incorporated, but not organized. It employs about 70 *operatives*, and manufactures about 5,000 yards of flannel per week.

The Lowell Bleaching; capital $500,000, employs 30 hands, and bleaches 124,000 yards per annum.

About a mile up the Concord River are extensive powder mills, owned by O. M. Whipple, Esq., *in which are made* 30,000 *kegs of superior powder annually.*

The Lowell Brewery, incorporated in 1828, with a capital of $50,000; and a worsted manufactory has just been commenced by Mr. Simpson, which employs 125 persons, and works off 1,000 lbs. of worsted per day.

It is also said that a Company is already formed, which has commenced purchasing cocoons, with a view of establishing a Silk Manufactory; and that the buildings are to be erected the ensuing spring.

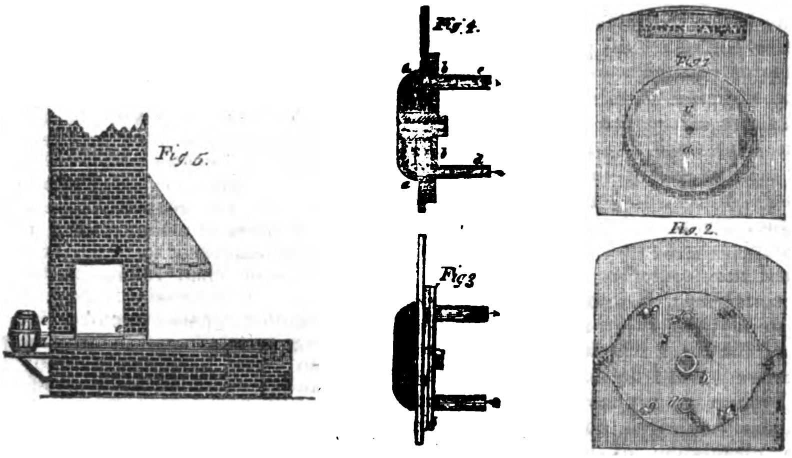
Lowell contains ten houses for public worship, three banks, a theatre, two large brick schoolhouses, and primary schools are located in every section of the town, and open at all times to the free access of the rich and poor.

There are in the whole about twenty-five factories in operation, and there yet remain unoccupied privileges for nearly as many more. When these *shall be* taken up, as they probably *soon will be*, they will furnish the means of subsistence to about another 15,000 inhabitants, which will make, in the whole, 30,000, and we see no good reason to believe that this number will ever be much exceeded.

A Railroad from Lowell to Boston is now completed, and the distance of 26 miles is travelled in from 55 to 65 minutes, including stops—and promises to be of immense utility to both places. There are two tracks, and it is said to be more permanently built than any other in the country.

S. B.

JOHN WEST'S IMPROVEMENT ON FORGES.



[From the Repertory of Patent Inventions.]

Specification of the Patent granted to JOHN WEST, *of Kensington, in the County of Kent, Blacksmith, for an Improvement on Forges.* Sealed December 9, 1834.

WITH AN ENGRAVING.

My invention consists in causing water to circulate within the back of the forge in order to carry off heat therefrom, whereby the back of the forge will be preserved from the prejudicial effects of the heat, as will be hereafter fully described.

Description of the Drawing.

Fig. 1, represents a front view of a forge back, which is made hollow in order to admit of a flow of water.

Fig. 2, is a back view of fig. 1, by which the position of the circulating pipes is shown.

Fig. 3, is a side view of a forge back; and

Fig. 4, is a side section by which the action of the water will become more evident, the arrows in this latter figure clearly indicating the flow of the water.

In each of these figures the same letters indicate similar parts.

It will be seen that the back of the forge is made up of the parts *a* and *b*, the part *a*, being the front or part against which the fire or hot coal lies, and is consequently that part which is liable, in the ordinary back, to be quickly destroyed, but when constructed in such a manner as to admit of a constant flow of water against the back surface, this part *a*, will be less prejudicially acted on by the hot coal, owing to the heat being constantly conveyed away by the circulation of the water. The part *b*, constitutes the back part of the forge back. These parts are put together by screws, *c*, as shown in the various figures, there being packing or luting at the joints in order to keep the same water tight. *d*, is the induction pipe, and *e*, is the eduction pipe, which respectively lead from and to a tub or vessel containing water, which is placed in any convenient situation in order that water may constantly flow to and from the hollow forge back, *a*, *b*, as is clearly shown in fig. 5. I would here remark, that the hollow forge back is to be set in like manner to ordinary backs of forges, and in other respects the forge is constructed as heretofore.

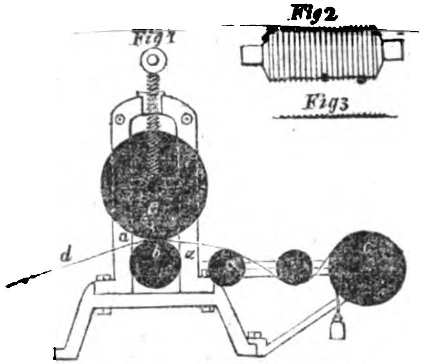
Having thus described the manner of applying my invention, I will shortly state the way in which it acts. The

heat of the fire against the part *a*, of the back of the forge will quickly heat the water contained in the hollow forge back, the consequence of which will be that the hotter particles will rise upward and flow off by the pipe, *e*, whilst a quantity of colored water will constantly flow by the pipe, *d*, to make up for that which flows off by the pipe, *e*, and thus will a continued circulation or flow of water take place in the hollow back of the forge, which, continually carrying off heat therefrom, will prevent the forge back becoming heated to that extent to which it has heretofore been liable.

In conclusion, I would wish it to be understood that I lay no claim to any parts of the forge which are well known and in use; and I do hereby declare that what I claim as my invention of an improvement on forges, consists in producing a circulation of water within the forge back, as above described. In witness whereof, &c.

Enrolled June 9, 1835.

Fig 2.



[From the Repertory of Patent Inventions, &c.]

Specification of the Patent granted to* THOMAS DE LA RUE, *Fancy Stationer, for an Improvement, or Improvements, in Manufacturing or Preparing Embossed Paper Hangings.

WITH AN ENGRAVING.

To all to whom these presents shall come, *Now know ye*, that I, the said Thomas De La Rue, do hereby declare the nature of my said invention, and the manner in which the same is to be performed, are fully described and ascertained in and by the following description thereof, reference being had to the drawing hereunto annexed, and to the figures and letters marked thereon (that is to say:)

Some attempts have been made to use embossed paper for the purpose of covering rooms in the way of paper hangings, but owing to the damp produced by the paste required in affixing such embossed paper to the walls, or to canvass or boards covering walls, must of the beauty of the embossing has been destroyed. Now the first object of my invention is so to prepare the back or part of the paper on which the paste is to be placed for the purpose of sticking it to the sides of the rooms in such manner that the water or moisture shall not affect the pattern embossed on the paper hangings, but the same shall retain its beauty and sharpness of impression. And, Secondly, my invention consists in embossing or impressing certain continuous and parallel lines on paper hangings, whereby to produce an increased brilliancy of effect of the light playing on or striking such paper hangings, and at the same time an evenness of color not observable in any embossed paper hangings heretofore manufactured.

Having thus stated, generally, the objects of my invention, I will proceed to describe the manner in which I carry the same into effect. Before having the paper embossed, when about to be prepared according to the first part of my invention, I size the back, or the side, which is to receive the paste, with a strong animal size (glue dissolved in water in the proportion of one pound in weight to a gallon of water) by means of a brush similar to those used by paper stainers, and permit the same to dry. The paper is then to be embossed as is well understood. I then lay on, by means of a brush, one or more coats of the spirit-varnish and oily materials hereafter described, over the back of such embossed paper, taking care that all parts are well covered, by which means the water contained in the paste which is used in sticking on the paper to walls or canvass, or wood covering of walls, will in no way injure the embossing or pressed lines formed on the paper, and thus will the embossed face of the paper retain its beauty and sharpness of embossing when pasted on to a room. And the materials I prefer to use for this purpose are as follows:—One pint of good drying oil, one pint of turpentine, one pint of japanner's gold-size, and ten pounds (in weight) of white lead previously ground in oil: these are to be intimately mixed together, and, as aforesaid, be laid evenly over the back of the embossed paper hangings, in one or more layers, the quantity requisite being readily discovered by a little practice: the great object to be obtained is so to cover

the back surface of the embossed paper hangings that the water contained in the paste shall not penetrate to the face, and thus destroy the sharpness and beauty of the embossing. The paper so prepared is to hang in drying-rooms at a temperature of about 75° or 80° of Fahrenheit, and in case of more than one coat, each coat is to be dried before the next is laid on. The second object of my invention is the embossing or impressing a series of lines parallel to each other, and in the way of the length of the paper hangings, that is to say, that when such paper hangings are applied to a room such lines shall be at right angles to the floor; the object of which lines is to obtain a more brilliant effect of the light playing or acting on paper hangings so prepared, that when the surface is flat or prepared by ordinary embossing, or what are termed waterings, like silks.

In order to carry this part of my invention into effect, I take paper hangings, either plain or with their intended designs printed thereon, and pass them between rollers, one of which is engraved with a series of parallel lines, either right lines or lines slightly waved, provided such lines run continuously in the length of the paper hangings, and in such manner that such lines, when the paper is stuck on rooms, shall run at right angles to the floor, supposing the floor to be horizontal.

Description of the Drawing.

The drawing, fig. 1, hereunto annexed, represents an ordinary embossing press; *a*, being the framing; *b*, the embossing-roller, shown separately in fig. 2; this roller has engraved or cut thereon a series of lines or grooves, such lines being parallel to each other, and when used for embossing paper, will produce thereon a number of lines in the way of the length of the paper, so that when such paper hangings are pasted on a room these lines will be at right angles to the floor, the consequence of which will be that the light playing on such paper will have a very peculiar and brilliant effect, such as cannot be obtained by lines passing in any other direction, and by this means much greater elegance and evenness of color and effect may be produced, even in common as well as the better class of papers. The paper hangings, thus embossed, are then to be prepared on the back, in like manner to that above described for preparing ordinary embossed paper hangings. It may be desirable here to remark, that where it is wished to have what are termed watered embossed papers, or any other embossed pattern produced according to the second part of my invention, then the engraving for that purpose on the roller must have the ground of parallel lines running in like manner around the roller, the patterns or designs being engraved in addition to such series of parallel lines, which are to run in the way of the length of the paper, and to be stuck to the walls of rooms in such manner that such lines shall stand at right angles to the floor, supposing such floor to be perfectly horizontal.

Having thus described the nature of my invention and the manner of carrying the same into effect, I would have it understood that I lay no claim to the embossing of paper, such process being well known and in use for book-binding, paper hangings, and a variety of other purposes: nor do I claim the parts of the apparatus shown for giving the line as above described: but I do hereby confine my claim of invention, First, in preparing the back of embossed paper hangings with spirit on oily substances suitable for resisting the moisture contained in the paste used for sticking such paper to the walls of rooms, whereby such embossed paper hangings will retain the sharpness and beauty of the embossing; Secondly, I claim the production of paper hangings with embossed parallel lines in the way of the length of the paper, that is, in such manner that when the paper hangings are pasted on to walls, such lines run upwards at right angles to the floor, as above described, and whereby an increased beauty of effect will be obtained from the light playing or acting on the surface of such paper. In witness whereof, &c.

Enrolled February 14, 1835.

[From the Journal of the Franklin Institute.]

On Steep Grades for Railroads. By A. C. Jones.

Gentlemen:—In reading the reports of new Railroads that are being located, I have been surprised to see that Engineers propose grades of one hundred feet to the mile, and state that locomotive engines will overcome them with ease;* this being only the case when the greater part of their load has been left behind, or when the assistance of another engine is afforded to aid the first one up the grade.

Inclined planes, with stationary engines, are serious evils on Railroads, and where the plane is such that it requires the power of another locomotive to surmount it, the evil is only lessened: far better would it be for the stockholders, if the Engineer should

* I have not seen the official account of the experiment of ascending the one hundred and seventy-six feet grade, on the Baltimore and Ohio Railroad; but it is not prudent to take a single experiment as a basis by which to form grades.

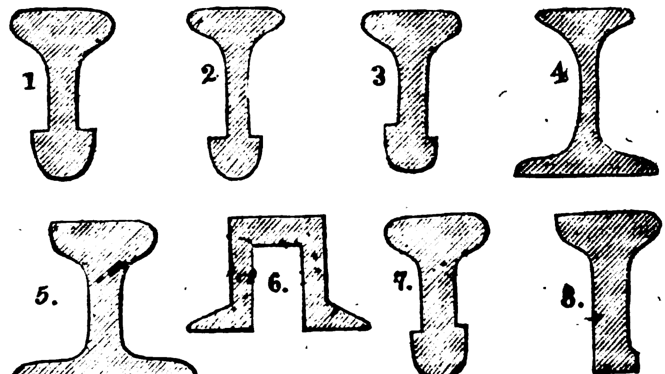
lengthen the road five miles, than to make a grade over thirty feet to the mile. Where the carrying trade is all one way, there is an exception to this remark, but then such grades are not consistent with safety.

It will be admitted by all, that the state of the water in the boiler of a locomotive engine is of considerable importance, and any person who has seen locomotive engines, with boilers of Mr. Stephenson's plan, will not have failed to notice the great change in the height of the water in the boiler, in passing from a level down a grade of twenty-five feet to the mile. This is easily accounted for, by the angle which the grade makes with the horizon, and as the water in the boiler will find its level, it flows to the lowest end: moreover the centre of gravity being thus moved forward, increases the weight on the springs in front, which are straightened in proportion, while part of the weight being removed from the hind part of the carriage, the elasticity of the springs will raise it up, and the cap of the fire box, and part of the flues, are liable to be left dry.

It may be urged by some, that the ebullition in the boiler will keep the flues wet; but as it is known, that in descending a grade exceeding one hundred feet, no steam will be required, and there being consequently no draught, the water will not be in violent ebullition.

Respectfully yours,
A. C. Jones.

Portsmouth, Va., Aug. 20th, 1835.



[From the same.]

Sections of Rails used in the United States. By J. C. Trautwine, Civil Engineer.

Gentlemen,—I send for insertion in the Journal of the Institute, transverse sections of eight varieties of parallel rails, employed on different Railroads in the United States. The figures are drawn to a scale of one fourth the full size, and accompanied by a statement of the weights, per lineal yard.

No.			Weights.	
No. 1.	Columbia and Philadelphia,	per yard,	41½	lbs.
2.	" "	"	33	"
3.	Germantown and Norristown,	"	39.	"
4.	Camden and Amboy,	"	39¼	"
5.	Boston and Providence,	"	54	"
6.	Wilmington and Susquehannah,	"	40	"
7.	Alleghany and Portage,	"	40	"
8.	Boston and Providence,	"	40	"

[From the Boston Mechanic.]

Native Artists and the Arts.—Perhaps the better way to cherish native ingenuity and enterprise would be, not to impose a tariff on foreign productions, but to be willing to encourage those of our own land, even at the risk of paying a higher price for them than for the foreign article; which will be the sure way to make them, by and by, cheaper, as it will so much the better enable the producers to work upon a more extended scale, and consequently, with greater facilities.

The more common trades, which require, comparatively, the exercise of little skill and little intellect, will get along well enough; but would we encourage the higher branches of the arts among us, we must assuredly take good care of the artists. It can hardly be expected that one should be able to acquire fortunes, in a business the acquisition of which, even to mediocrity, is a labor of many years, requiring much capital, as well as extensive study, research and experiment, for its successful prosecution, and the proceeds of which, after all is done, must be costly—and often not only so, but having

necessarily a limited demand, as is the case with philosophical and astronomical instruments, —unless some peculiar encouragements should be afforded by efficient patrons of the liberal arts and sciences.

Nevertheless, these articles must be had, and made, by somebody. Somebody must take upon his shoulders the expense, and incur the difficulties which lie in the way of their successful construction. In this country, the prosecutors of these branches of art, as well as the cultivators of the sciences, have a great disadvantage compared with those of the old country. There is here no *royal* favor, no royal munificence, to be lavished upon the deserving or the undeserving; there are no royal patrons of the arts and sciences, ready to bestow both their sanction and their guineas upon the makers of important improvements and discoveries. Unwilling as we plain republicans are, to allow a grain of superiority to kingly governments, we are obliged to confess that however they have oppressed their people, they have been efficient promoters of science and the arts.

But our native pride will, we think, prevent us from answering in the negative the question—'Are we not able to give as ample support to *these* pillars of civilization, as we are to our boasted freedom, and to the rights of man?' And if this question be answered—'Yes,' we believe it will be truly answered. Why is not our *government* able to bestow as efficient patronage on scientific research and discovery as the royal associations, which so liberally dispense rewards and favors in Old England?

But it is true that science and the liberal arts have not met, in this country, with that encouragement which is necessary to their prosperity. The best and almost the only *general* standard scientific journal among us, has languished, for want of aid. Our artists have preferred even to leave the land of liberty, for the sake of finding a clime where they might reap a profit from their labors.

But it will not be so always. If the disasters of another revolution should not suddenly overtake us, (which may God avert,) we cherish a hope of soon seeing the ways of knowledge and scientific research as profitable, and as generally honored, as the less intellectual pursuits which so absorb the minds of a great portion of us. Nor do we fear that in heaping rewards upon the pioneers of useful knowledge, in its high and difficult departments, we shall the more degrade those by whom these honors are unattainable. No! we are assured, on the contrary, that before these heralds of science can be, among us, suitably rewarded for their exertions, the people must be *raised*—not depressed; instructed—not fettered in ignorance; taught enough of science to respect it for its own sake, instead of bowing down blindly and wonderingly before its possessors.

We regard, then, the education of the people, and the cultivation of the higher branches of science and art, as causes which must go hand in hand, and stand or fall together. The *people* are sovereign here; and what kings are not here to do, with their royal munificence—perhaps extravagance—the people must do by their liberality and patriotism. They who give law to the land, must give strength to the wings of genius, and themselves urge forward the wheels of research and invention, if they would see the temples of science and art, rising beside those of liberty. A——z.

[From the same.]

ILLUMINATED STREET SIGNS.—Messrs. Editors:—I wonder whether it is because everybody that can reasonably be expected to be interested in city improvements, knows all the streets by heart, that no attempt has ever been made to render the names of the streets at the corners, visible in the night-time. Were lamps hung against those signs—and that would be, as far as I can see, as good a place, for all other purposes, as they generally occupy—the evil would at once be remedied. In England, where they go a-head of us in every thing, except in the matter of the freedom of the people, &c., of which we are wont to boast, they have contrived the plan of embossing or painting the names of the streets on the cross-bars placed for the lamp-lighters' convenience at the top of the lamp-posts. The sides of the said bars being slanted off somewhat from above, the light from the lamp falls down and illuminates the name, so that it may be read. It might be well,

I think, for some of our wiseacres to meditate profoundly for a while on this subject, laying by, for a season, perpetual motion and cooking stoves, of which articles there is already an abundance in market. MORE LIGHT.

EXPLANATION OF TERMS.—There are those who would read works on natural philosophy, were they not deterred by meeting with words which they cannot understand; of some of which they might search in vain for a satisfactory explanation in our common dictionaries. One is, however, by no means justifiable in declaiming against the use of technical terms; which cannot always be avoided, in the plainest treaties upon many scientific subjects. Those who wish us to bring every thing down to their comprehension, lay themselves open to the suspicion of being, in fact, too indolent to climb to the height which the subject ought to occupy; or at least, we must suppose them forgetful of the fact that in treating of things not commonly spoken of, we must sometimes employ words not commonly made use of.

The following explanations of terms in frequent use in scientific and practical treaties, will, it is believed, be found both useful and clear. The list may perhaps be hereafter extended.

Specific Gravity.—The difference in weight of equal bulks of different substances. See a particular illustration in No. 3, (May,) 1835.

Square.—In arithmetic, the product of a number multiplied by itself, as 25, which is 5 times 5; 144, 12 times 12. The numbers 5 and 12 are also called the square roots of 25 and 144 respectively, and so on.

Square of the Distance.—Certain things, in philosophy, as the force of gravitation or attraction, and the intensity of light, are said to decrease in the ratio of the *square of the distance.* The meaning is this:—Suppose a body to be placed, say two feet from a light, or the centre of an attracting body, as a magnet, and another body 4 feet from the same. These bodies will be attracted, or illuminated, not in proportion to their distance, that is as 2 to 4, or in a double ratio, but as the *squares* of the distances; viz, as 4 (the square of 2,) to 16, (the square of 4,) that is to say, in a quadruple ratio; and in the same manner, if the second body was removed 10 feet off, it would be illuminated by the light, or attracted by the magnet, only in the proportion to the former of 4 to 100, (10 × 10.)

Gravitation.—Attraction; applied exclusively to the attraction of the earth for bodies falling towards it, and that of the heavenly bodies for each other.

Centrifugal Force.—A force tending to throw any thing revolving, from its centre of motion, as water poured on a grindstone is thrown off, when the stone is turned rapidly.

Centripetal Force.—That which tends to draw a revolving body *towards*, or *hold* it near the centre of *motion*, as a *string* retaining a ball whirled in the air by the hand.

Oxyde.—Rust. A mixture of oxygen with metallic substances.—[Boston Mechanic.

INTERESTING EXPERIMENT.—A bar of iron heated to whiteness, being held against a strong current of air from the blowing apparatus of a forge, instead of cooling, as might have been expected, burned brilliantly, throwing off scintillations in every direction. The editor of the Scientific Tracts, who relates the account, does not undertake to account for it; but it is evident that the additional oxygen thus forced upon the already ignited metal, promoted the continuance of the cumbustion, chemically, in a much greater degree than its cooling power retarded it.—[Ibid.]

THE AXE.—The power of the American Axe (says Latrobe in his book on the United States,) and the skill with which it is wielded, may well excite the admiration of a European. The weapon itself is no more to be compared with the vile copper commonly seen in the hands of one of our woodmen, than a gimblet can be compared to a centre bit. It is formed upon a different principle—the handle is set far forward, and it acts upon the tree, more from the wedgelike form, its own weight, and the skillful swing which gives it impetus, than from any great exertion of strength on the part of the woodman. In fact slight more than strength is employed in its use. The rapidity with which the huge trees of the forrest fall before a single pair of well swung axes is really marvellous; and the axe may rank with maize and steam as one of the three things which have conquered the Western World.

[From the Journal of the Franklin Institute.]

Essays on Calcareous Cements. By JAMES FROST, *Esq., Civil Engineer, New-York.*

Sir,—Having, many years since, in my native country, [England,] formed various calcareous cements, of a beautiful color, by a new process, which cements appeared to be very hard, and to become more so, I was desirous of comparing them with other hard substances, and of obtaining, if possible, their relative value, without injuring the specimens. This object was satisfactorily attained by abrading them, by means of fine emery and water, against a standard piece of white statuary marble, and calculating their relative hardness from the weight lost by each substance in the operation.

It soon became evident that the term strength would better define the result than the term hardness, which being an abstract quality, always in combination with another abstract quality, tenacity, jointly constitute strength, by which all change of form is resisted. Statuary marble was used as the test for all substances, from brass to work stone, inclusive, which latter substance was used to test the weaker articles, while the stronger were tested in succession with each other.

As another attempt to obtain similar information was recorded in the Annals of Philosophy, by Mr. Bevan, in the numbers for March and April, 1831, and as that gentleman operated on some of the same substances by percussion, and obtained thereby somewhat different results, a careful consideration of the two modes employed seems to indicate that percussion is rather a measure of tenacity, and abrasion a measure of hardness.

In measuring the minute differences of hardness in substances nearly similar, abrasion is evidently the only means of obtaining satisfactory results.

I shall defer the details relative to the strength of calcareous cements, which it is my intention hereafter to furnish, only stating, that I possess a collection ranging from 1 to 580; but I shall, in due course, enter fully on these curious and important distinctive properties. I shall thus place at your disposal the results of a long course of experiments, made on a large scale, with a view to improve the theory, formation, and useful application, of these interesting substances.

As there are few scientific subjects respecting which there are so many conflicting theories, and, amongst practical men, so many different opinions, you may perhaps consider an attempt at elucidation and improvement worthy of the attention of your numerous scientific and practical readers.

Comparative Strength with which various Substances resist Abrasion.

Hard cast-steel,	6014
——— yellow tempered,	3184
——— blue tempered,	1592
Soft gray cast-iron,	1293
Black flint,	1939
Rock crystal,	1600
Aberdeen granite,	980
Broner stoneware,	950
Yellow brass,	675
Wedgewood's evaporating basin,	600
Copper keg,	525
Hard Yorkshire paving stone,	327
Old blue Purbeck "	318
Italian black marble,	260
Forest marble,	200
Common unglazed earthenware,	193
Sienna marble,	177
Kilkenny black marble,	110
Statuary marble,	100
Old Portland stone,	79
Roman cement stone,	69
Roman cement, (12 months old,)	58
Fine grained Newcastle grindstone,	53
Welsh blue roofing slate,	41
Fluor spar,	39
Stock brick,	34
Calcareous spar, (Iceland,)	33
Wirth sand-stone, (Sussex,)	17
Coarse grained Newcastle grindstone,	17
Bath stone, (Oolite,)	12
Chalk at Barton on Humber, (Cawk,)	15
" at Dover, (fossil bed,)	6
Gypsum, uncalcined,	5
Plaster of Paris, (3 months old,)	.40
Thames chalk,	.18

[From the Journal of the Franklin Institute.]

Alloys, Solders, and Amalgams, used in the Arts.

Gentlemen,—The following table of the alloys and amalgams used in the arts, has been prepared by Mr. Chaudet, a distinguished and experienced assayer in the mint of Paris, from actual analysis of carefully selected samples. In a few instances, the proportions of the composing metals are not given, for reasons that, in one instance at least, are obvious. This deficiency is more than compensated by the addition of several others, particularly that of the alloys of Palladium, which I have added, in the full persuasion that the whole will be found useful. Yours, &c.

FRANKLIN PEALE.

Table of Alloys, Solders, and Amalgams, used in the Arts.

Alloy of Gold Coin.—(French Standard.)

Gold,	900	1000
Copper,	100	

Alloy of Silver Coin.—(French Standard.)

Silver,	900	1000
Copper,	100	

Alloy of "Billon."—(French Standard.)

Copper,	800	1000
Silver,	200	

Alloy of Gold Medals.—(French Standard.)

Gold,	916	1000
Copper	84	

Alloy of Bronze Medals.*

Copper,	92	100
Tin,	8	

Alloy of Jewellery.—(French Standard.)

Gold,	750	1000
Copper,	250	

Alloy of Silver Plate.†—(French Standard.)

Silver,	950	1000
Copper,	50	

Alloy of Gold Coin.—(U. S. Standard.)

Gold,	899.22	1000
Copper and Silver,	100.58	

Alloy of Silver Coin.—(U. S. Standard.)

Silver,	892.43	1000
Copper,	107.27	

Alloy of Gold Coin.—(English Standard.)

Gold,	916.67	1000
Copper and Silver,	83.33	

Alloy of Silver Coin.—(English Standard.)

Silver,	925	1000
Copper,	75	

Alloy in imitation of Gold.

Copper,	91.00	100½
Tin,	9.50	

Alloy in imitation of Silver.‡

Copper,	61.27	106
Zinc,	28.78	
Nickel,	15.13	
Lead,	.82	

Alloy for Cannon.§

Copper,	100	111
Tin,	11	

Alloy for Statues.‖

Copper,	91.40	100
Zinc,	5.53	
Tin,	1.70	
Lead,	1.37	

Alloy for Bronzes and Candelabras.

Copper,	82.00	104½
Zinc,	18.00	
Tin,	3.00	
Lead,	1.60	

* The medals made from this alloy are cast; they have the advantage of being struck by a few blows of the press, and of wearing a long time.

† The standard here indicated is the best; a second is composed of 800 of silver, and 200 of copper, in the 1000.

‡ This alloy is the Packfond of the Chinese.

§ In this alloy, small quantities of lead and zinc are often found, but they are present by accident.

‖ The proportions here indicated are the result of an analysis of the beautiful bronze statues of the garden of Versailles, which were cast by the Brothers Kellers, celebrated founders, employed by Louis XIV.

Alloy for the Mounting of Fire-arms.

Copper,	80	100
Zinc,	17	
Tin,	3	

Alloy for Cymbals,* Tam Tams, or Chinese Gongs.

Copper,	80	100
Tin,	20	

Alloy for Bells.

Copper,	75	100
Tin,	25	

Alloy for the Reflectors of Telescopes.

Copper,	2	3
Tin,	1	

Alloy for Brass for the Lathe.†

Copper,	65.80	100
Zinc,	31.80	
Lead,	2.15	
Tin,	0.25	

Alloy of Brass for the Hammer.‡

Copper,	70.10	100
Zinc,	29.90	

Alloy for Types.§

Lead,	80	100
Antimony,	20	

Alloy fusible in Boiling Water.

Bismuth,	8	16
Lead,	5	
Tin,	3	

Alloy for Plugging Teeth.‖

Bismuth,	8.	17.6
Lead,	5.	
Tin,	3.	
Mercury,	1.6	

Alloy for Tinning Iron.

Tin,	8	9
Iron,	1	

Alloy used to make Ductile Gold of 18 carats, or 950 milliemes.¶

Copper,	990	1000
Gold,	10	

Alloy for Bells of Mantel Clocks.

Copper,	75	100
Tin,	25	

Alloy for the Pivots of Artificial Teeth.

Platinum,
Silver,

* This alloy is very hard; it is annealed by dipping, while red hot, into water, and is then malleable; whilst, if suffered to cool gradually, it is excessively hard; this important fact is due to M. d'Arcet, who has thus furnished the means of fabricating, in France, cymbals, &c., formerly imported, at great cost, from China.

† The proportions here indicated having been found by analysis, it is evident that the tin is present by accident.

‡ This alloy of brass is important, and is due to Mr. Chandet.

§ Sometimes a small quantity of copper is added to these two metals.

‖ This alloy may be prepared with a smaller proportion of mercury; it melts at 65 deg. of the Centigrade scale.

¶ The previous combination of the alloy is found to produce ductile gold, when the same metals would prove the contrary, if mixed directly.

Alloy for ditto.¶

Palladium,	50	100
Silver,	50	

Alloy for the Springs of Artificial Teeth.*

Palladium,	50	160
Silver,	50	
Copper,	50	
Iron,	10	

Solder for Gold of 750, or 18 carats.

Gold of 750,	2.00	3
Copper,	0.50	
Silver,	0.50	

Solder for Silver of 750.†

Silver,	2	3
Brass,	1	

Solder for Brass.

Copper,	50	100
Zinc,	50	

Solder for Lead.

Lead,	2	3
Tin,	1	

Amalgam of Gold for Gilding on Metal.

Mercury,	91 to 89	100
Gold,	9 to 11	

Amalgam of Silver.

Mercury,	85	100
Silver,	15	

Amalgam for taking Impressions of Seals.‡

Copper,		
Mercury,		

Amalgam for Silvering Mirrors.

Tin,	70	100
Mercury,	30	

Amalgam for Silvering Globes of Glass.

Mercury,	80	100
Bismuth,	20	

Amalgam for the Cushions of Electrical Machines.

Mercury,	2	4
Tin,	1	
Zinc,	1	

Among the twenty-three metals that are not enumerated in the foregoing list, there are several that enter into alloys, but they are without utility in the arts; we should not, however, include in the remark, the native alloy of Osmium and Rhodium, which is excessively hard, and is at present used for the nibs of metallic pens.

Care has been taken in the arrangement to name those metals first, which enter in the largest quantities in the alloy.

¶ This alloy is extremely important; it is used for all those purposes in the fabrication of philosophical instruments, for which platinum was formerly applied, being superior to it in hardness and color, and yet inoxidable under all the usual circumstances.

* An extremely useful alloy, having a degree of elasticity only exceeded by steel, with all the advantages of superior lightness and hardness over platinum; this, and the preceding, are due to Mr. Percival N. Johnson, of London.

† The copper and zinc ought to be taken in the form of brass; for two parts of silver, take one part of brass.

‡ This amalgam is hard, and melts at a low heat; it was used by the French police, under the administration of the celebrated Fouche, for the purpose of opening and resealing the letters that passed through their hands.

On the Praticability of Alloying Iron and Copper. By David Mushet, Esq.

In perusing, the other day, Dr. Lardner's third volume on metals,* I met with the following unqualified assertion: "As to alloying copper with iron, the notion not only appears absurd, but unsupported by evidence." As at the present moment Dr. Lardner's publication may be considered a text-book of popular instruction, such a statement might lead to a settled conclusion that to alloy iron and copper is, under all circumstances, impossible. Now the contrary is the fact; and having considered this operation for many years, as one which, if happily effected, would materially contribute to the perfection of many of our mechanical contrivances, I hope I shall be excused for entering on the subject somewhat particularly.

In the first place, I see no *prima facie* reason why it should be absurd to expect that iron should unite with copper as well as it does with other metals. Then as to the evidence, I think that most chemical works state the fact as a matter of course, never doubting the practicability of the measure; and in your own Magazine, vol. xlix., I find some experiments on the union of iron with copper; which shows that the subject has not been recently altogether overlooked. The uncertainty which prevails upon the subject arises from the want of accuracy in defining the nature and quality of the iron which has been the subject of the union. Most of the books entirely overlook the various states of iron, and fail to distinguish whether the subject-matter of the experiment was cast iron, or steel, or iron in a state of malleability. The same remark applies to the experiments of Mr. P. N. Johnson as above, who, though he states that he effected an union between iron and copper, yet leaves it doubtful whether the iron was not steel or cast-

* "Manufactures in Metal, vol. iii. Tin, Lead, Copper, Gold, Silver, and various Alloys," p. 174.

iron instead of pure or malleable iron. The well-known affinity of iron for carbon precludes the possibility of malleable iron being heated and melted in contact with a large dose of charcoal (as was the case in his experiments), without its passing into the state of steel, or cast-iron; so that the experiments of Mr. Johnson may be considered as representing, not the union of copper with wrought or malleable iron, but with cast steel or crude iron. Whether or not these were examples of a real chemical alloy, or of a mere mechanical mixture, may be gathered from the following remarks, which are grounded on an extensive series of experiments.

It had for many years appeared a desideratum to me to form castings for shafts, cranks, levers, beams, &c., of a substance that should possess the stiffness of cast, together with the power of tension and strength of wrought iron. It occurred to me that such a discovery would enable the engineer to construct more complete and convenient forms (particularly in the machinery belonging to steam-boats and locomotive engines), than he is at present able to obtain from the cumbrous forging, turning, and fitting of malleable iron. Such an union of strength I naturally sought for in a mixture of iron and copper; and knowing that the copper ores of this country are principally sulphurets of iron and copper, I commenced my experiments by attempting the joint reduction of the iron and copper. After many failures I so far succeeded as to effect a perfect reduction into malleable matter of the whole contents of any given sulphuret. But upon examining the results, it was found that a very great uncertainty prevailed as to their strength and quality; and I soon ascertained that I had only succeeded in obtaining a perfect separation from the ore, of the united products of iron and copper. These masses of alloy were arranged and classified as follows:

1st. Ingots of a coppery colored surface, covered with an exterior blackish shale in cooling resembling iron; breaking with a pale uniform homogeneous fracture, and producing an action more or less on the magnetic needle.

2ndly. Ingots with a gray coppery surface, covered also with an exterior blackish shale in cooling resembling iron, the under surface of a deep red coppery color. Fracture specular, and beginning to exhibit distinct grains of copper apart from the iron, as if this metal had been saturated with copper. Small hard and bright iron points appeared under the file. These ingots were obedient to the magnet.

3rdly. Ingots with an iron-colored surface, and coppery tints displayed under a black thin shale. Hard, and filing to a coppery color, mixed with bright spots. Fracture specular, exhibiting a mixture of iron and copper, in which the former appeared to *prevail*. Powerfully acted *on by the magnet*. *The lower* surface cellular and crystalized, resembling products of fused steel.

Though I have divided these products into three classes only, yet I obtained many intermediate results, the iron present in which I estimated at from 5 to 70 per cent. of the weight of the copper. Beyond 5 or 7 per cent. of iron, no chemical union took place; and as the quantity of iron revived, was in proportion to the charcoal added, so in the same proportion did the separation of the two metals from each other take place. From this it was inferred that malleable iron (*i. e.* iron containing the least possible quantity of charcoal), would unite and form a proper alloy with copper, but that steel or cast iron would not do so. To try the validity of this reasonioning, a new series of experiments was instituted, having for their object the direct union of a portion of copper with iron in various states of cast iron, steel, and malleable iron, the general results of which I will state as briefly as possible, without going into a detail of the various experiments.

Pure malleable iron may be united with copper in any proportion, until it equals, or even exceeds, the weight of the copper; the intensity of the copper color increases, till the quatities are equal; and the fracture then becomes paler, in proportion as the quantity of iron exceeds that of copper. With 50 per cent. of iron the alloy possesses great strength: its hardness increases with the quantity of iron, but its strength afterwards decreases, and in cutting, it opens before the chisel. The loss of strength in pro-

portion as iron is added, arises, I imagine, from the fibre of the copper being injured by the very high temperature required to fuse the increased quantity of malleable iron. The fracture of the ingots thus obtained is always specular, with a glance arraggement, which betokens a tendency to brittleness.

If steel is fused with copper in the proportion of one-twentieth of the latter to nineteen-twentieths of the former, an ingot resembling, and crystallized like, cast-steel, will be obtained, but useless for forge purposes, and incapable of receiving an edge. Not the slightest symptom of copper, either on the surface or in the fracture, can be perceived, but a very considerable increase of hardness may be observed.

When copper is fused with one-tenth of its weight of bar steel, an ingot is obtained which outwardly resembles the former, with the radiated linear crystallization less distinct. But the fracture, which is hard and brittle, shows, by minute points of copper, the commencement of an indisposition, or inability, to further union, or alloy, between the two metals.

Again, when one-fifth of the weight of copper is added of steel, an ingot is obtained, which exhibits, when filed, a partially coppery appearance, of a deep red on the lower, and steel bright on the upper surface. The fracture displays a regular grain, which indicates an intimate mixture of copper and iron, apparently of greater strength than in the two former alloys.

When one-third of copper is added to the steel, the former seems to separate, and sinks in considerable quantities, in a soft and malleable state, to the lowest part of the crucible. The fracture exhibits the copper in streaks and knots, indicating a decided want of union.*

White cast-iron, which resembles steel in the quantity of carbon which it contains, affords nearly the same result when fused with similar portions of copper; the alloy, however, possesses less strength, and a greater tendency to disunion when the proportion of copper is increased beyond one-twentieth.

The union of copper with gray cast-iron, if at all practicable, must take place in very minute quantities; for in fusing 5 per cent. of copper along with No. 1, or smooth-faced pig iron, specks of deep red colored copper were found upon the lower surface of the ingot, and similar traces were discernible in the fracture. With one-tenth the copper became of a deep red color, separated in leaves, and attached itself to the outside of the cast-iron; and when copper to the extent of one-fifth was tried, a solid bottom of copper was found beneath the cast-iron in the bottom of the crucible.

From all I have learnt on this subject, I conclude that copper unites with iron in proportion as the latter is free from carbon; hence it would appear impossible to produce a mixed metal, or alloy of copper and iron, by smelting in a blast furnace, in contact with carbonaceous matter, an ore containing both these metals. It is true that we have ores which, when properly smelted, would afford, at the first fusion, crude steel, which contains a minimum dose of carbon, and to which might be added as much copper as would chemically unite with it, probably from 5 to 7 per cent. But this quantity, I am afraid, would be too small, to form an alloy possessed of the strength and power of resistanee necessary to make cas ings for the purposes already mentioned.

Though I have clearly established, by numerous experiments, the practicability of a perfect union of malleable iron with copper, in every reasonable proportion, yet as this alloy can only be made in a close crucible, it is obviously impossible to employ it for castings of a considerable weight or size. I do not, however, despair of overcoming this difficulty, and of gaining the object I have long had in view, by a different system of alloy, in which copper must necessarily form an essential ingredient.—[Rep. Pat. In.]

* Steel, both English and Indian (or wootz), was alloyed with copper, in the proportion of two per cent. of the latter, by Messrs. Stodart and Faraday, in their experiments on the alloys of steel; but of the value of this alloy, they observe, "we have doubts." They did not attempt to produce it in the large way. See Quart. Jour. of Science, vol. ix. p. 285, 290; and Phil. Mag. vol. lvi. pp. 31, 54; vol. lx. p. 371.—Edit.

Substitute for Indigo.—A Company has been formed in London for the manufacture of a substitute for Indigo, from whose prospectus the following are extracts. "The objects of the Company are

to encourage the manufacture, and to bring into general use, the *British Substitute for Foreign Indigo*; and to dye wool, stuffs, cloths, silks, and other fabrics *blue or other colors* (for which indigo is now used), with this substitute, in the preparation of which a new and wide field will be opened to the industry of this country.—By the use of the substitute, a considerable saving will accrue to the manufacturer, and the colors produced, such as *blues, blacks, greens, bronzes, browns, and various others* will be so fast as to resist the action of *light, air, and friction*. The articles so dyed will not turn white at the *edges or seams*, a quality long sought after, particularly in stuffs or cloths for furnitures and other purposes, in which exposure to light and heat is inevitable, and hitherto has proved destructive of their colors. Independently of fastness, a brilliancy of color will be produced by the *substitute*, which cannot be attained with *indigo*." "For more than half a century the first chemists of Europe have directed their best energies to the discovery of some means by which a perfect and uniform blue dye (other than indigo) might be obtained. Hitherto their researches have been unsuccessful, insurmountable objections presenting themselves in the caustic qualities of Prussian blue (the only known substitute) in some processes hardening the wool when dyed and rendering it difficult to work, and in others destroying its fibre. At length a process has been discovered, for which a patent has been obtained, effectually neutralizing the objectionable properties of the component parts of Prussian blue. A patent has also been obtained for the manufacture of the prussiates of potash and soda, rendering them fit for many purposes to which hitherto they have been inapplicable, whilst they are in every respect, in conjunction with certain ingredients, a perfect substitute for indigo as a dye for wool, &c. Facts which have borne the test of extensive experiment, demonstrate this substitute in all respects to be equal, and in many superior to, far exceeding in brilliancy and durability, any dye obtained by the use of indigo. By a new process (also patented) the wool may be dyed either in the flock, the fleece, the yarn or skein, or when woven into cloth. So also cotton, in skein or piece, silks and all organic substances, may be dyed with facility of any shade, and of a fast and durable color. The manufacture of hats may be materially improved by this discovery, because a most brilliant and fast color is produced by using the ingredients alluded to in the combination forming a black, which will resist the action of light and air, elements fatal to indigo. The materials of which the substitute for indigo is composed, are in great abundance both in England and Ireland, but at present they are in most instances wasted. Their conversion into prussiate would provide extensive employment to that class of society (particularly in Ireland) who stand most in need of it, viz., the most indigent, as will be apparent from the following observations. The articles alluded to are blood, horns and hoofs of animals, bones, fish, cuttings of leather, old harness, and all other kinds of animal substance, old woollens, the refuse of woollen manufactures, old garments, &c. Substances the best calculated for the purpose, such as blood, fish, &c., are not rendered less useful by being in a corrupt state, for even animal manure may be used with some advantage. It is well known that in Ireland, the quantity of cattle slaughtered for the Government service, for export, and for the supply of our mercantile marine, is very considerable. The blood of those animals is now almost all wasted, as well as a great quantity of other animal matter forming the offal. The same remark applies to many parts of England, where, in numerous instances, those really valuable substances are not only unproductive of benefit, but entail great expense in the very prevention of their being productive of injury. Whole cargoes of fish are frequently thrown away in consequence of their corrupt state. Inconvience and loss, therefore, are the least part of the argument, as their causes but too frequently contribute to engender sickness and contagious maladies; so that a demand for, and consumption of these substances, even in a corrupt state, would not only open a new source of employment to the poor, but would very materially tend to the salubrity of all the principal towns in the United Kingdom, freeing them from filth and contagion. This discovery, therefore, it is submitted, ought, if for this reason only, to be looked upon in a national point of view, as offering, among inferior benefits, certainly a new source of employment for the indigent classes of this kindgdom, and above all, a remedy against the accumulation of impure matter corrupting the atmosphere of our populous towns. The articles combined with animal substances in the preparation of the new dye, are potash or soda, acid, and iron. Any object causing an increased consumption of the first mentioned article would materially benefit the Canadas, and improve the situation of our emigrants in that quarter of the world, promising as it is at present. But should potash become scarce, soda will answer every pupose in the manufacture of the substitute for indigo, and an increased demand for that article might advantage the poor both

in England and Ireland, were they to be employed in converting salt into soda. The same observation applies to a new demand for acids, particularly since muriatic and sulphuric acids will be principally employed in these operations, and they are, almost exclusively, the produce of Great Britain. In reasoning on the foregoing observations, it may be necessary, 1*st*, To give a statement of the actual quantity and value of the indigo consumed; 2*dly*, To compare that value with the estimated cost of the substitute for it; and, 3*dly*, To point out some of the advantages which cannot fail to arise to our manufacturers from the use of the substitute. As regards the first, reference being made to Marshall's Statistical Tables, it will appear that the average annual quantity of indigo entered *for consumption*, from 1814 to 1831, both inclusive, was 2,438,245 lb.; that is to say, the quantity remaining, after deducting the quantity exported from the gross quantity imported, will give the average prefixed. But the same author states, that the quantity thus arrived at is not the true measure of consumption, since the stock on hand and in bond at the commencement of this era has been gradually decreasing. The average quantity consumed in Great Britain may, from these data and corroborating information, be taken at three millions of pounds per annum. The prices of the eighteen years aggregated give—

	s.	d.		s.	d.
For low qualities,	53	7	a	75	4
And for fine qualities,	178	2		204	0
	231	9		279	4
				231	9
				511	1

leaving, as a result from the general average of the eighteen years, a medium price of 7s. 1½d. per lb. The price of indigo is not lower than it was in 1831; whilst the manufacturers are now induced by experience to employ the finer description of indigo, finding their advantage in so doing exceeds economy in price. But as the valuable tables alluded to cannot extend to a perfect computation of the relative proportions of fine, middling, and low qualities, a mean price of 5s. per lb. will be assumed in the following observations, at which price the value of the indigo annually consumed would amount to £750,000. As regards the second and third remarks, it may only be necessary to state that the cost of the substitute need never exceed an average of 2s. per lb. It would thus produce an annual saving of £450,000, independently of the material consideration, that the gross amount of cost, £300,000, for the manufacture of the substitute, would be expended on what is now wasted in this country, and in the labor of its poor inhabitants. The saving in the cost of the dye would enable the manufacturer to increase the wages of his workmen, or to sell the articles he may produce at a lower rate than those persons can who may continue to use indigo. The beneficial consequences would soon be felt in foreign markets, where English woollens are affected by a tariff on their declared value or cost of production, as in the United States of America, South America, Mexico, Hayti, and in some parts of the continent of Europe. There the British manufacturer would be enabled to undersell the woollen manufacturers of Germany, &c.; and this observation applies equally to cotton and other articles. At present the woollen manufacturers of Germany are underselling the British, in consequence of their purchasing indigo equally low, and procuring labor at a more moderate rate. In Ireland, formerly, an extensive manufacture of woollens was carried on; now, the greater part of those establishments are closed; but with capital (not large), and the advantages provided by the substitute for indigo, they might be put into a state of activity, giving to the population what chiefly they require—employment, to render them as industrious, peaceable, and contented as any subject in his Majesty's dominions. The subject is open to another important remark: Indigo is an article liable, in the event of war, to an immediate and a very considerable rise, by reason of an increased value of gold and silver, the increased charges for freight, insurance, and commissions, consequent thereto; whereas, the price of the principal ingredients in the substitute for indigo would, in all probability, be decreased by the contingency becoming yet more abundant, in consequence of the extension of the Government contracts for salted provisions. The Government of France, under the Emperor Napoleon, offered a reward of one million of francs to the person who should discover a substitute for indigo in dyeing woollens. That offer cannot now be made available; but the King of the French takes a lively interest in this discovery, and would desire to reserve its advantages exclusively for France. Samples of wools and cloths dyed by this new process were exposed at the late public exhibition in Paris, and orders have been issued by the French Government to prepare with it cloth for the clothing of part of the French army. Samples of these cloths, and of wools dyed on the new plan, are now in London, and may be inspected at the Company's Office; as also samples of cloths and stuffs dyed in London, at

Messers. Green and Whiteheads. Among these specimens are some literally worn threadbare—the color still as fresh as when first dyed. To revert to the question of economy, let it be observed, that, in using the substute for indigo, one pound of it will dye a] larger quantity of material than the like weight of indigo."—[Edinburgh Quarterly Journal of Agriculture.]

[From the Journal of the Franklin Institute.]

Report of the Committee on Science and the Arts, of the Franklin Institute, on Mr. J. K. Smith's Self-Acting Brake for Railroad Cars.

That this invention consists in a rod, or slide, attached to the front part of the frame of the car, which is pressed in whenever the car comes in contact with the one before it; the motion of this slide brings the brakes into contact with the wheels, by means of a suitable arrangement of levers, or by a chain passing around a pulley. As soon as the contact of the car ceases, the brake is freed, either by its own weight, or by a spring.

As Mr. Smith claims the principle of acting upon the brakes by the contact of the cars, and has proposed several different modes of effecting this, it is unnecessary to describe any particular arrangement.

The principal advantages of this invention are, that it will relieve the engine from the pressure of the train, when about to be stopped, and will prevent the hinder cars from rushing upon those in front, should their speed be suddenly checked by any casualty, and may thus prevent the lamentable effects with which these accidents are frequently attended. It occurred to some members of the committee, that these brakes might produce an unpleasant jerking when starting or stopping, and when travelling over a curved or an undulating road; but they are informed that several of them have been in use upon the Little Schuylkill Railroad for some months, and that no such unpleasant effect has been experienced. There is, however, one difficulty attendant upon the use of this contrivance, for which no remedy has been suggested. Whenever it becomes necessary to back the train, all the brakes must be thrown out of gear, and the time consumed in this operation may be of the greatest importance at a critical juncture. Notwithstanding this objection, the committee are of the opinion that the use of this brake will tend to diminish the danger of railroad travelling, and they would recommend a trial of it to those who are concerned in that mode of transportation, believing that it will be found worthy of their attention, both in a benevolent and profitable point of view.

By order of the committee.

WILLIAM HAMILTON, Actuary.

August 15th, 1835.

[From the American Railroad Journal.]

LONG LEVELS, WITH STEEP GRADES, in preference to a more uniform distribution through the whole line of the elevation to be overcome, appears to be the opinion of several of the most eminent Engineers in Great Britian.

We publish to-day several extracts from an examination before the House of Lords, of Mr. *Vignoles*, Mr. *George*, and Mr. *Robert Stephenson*, Mr. *Henry R. Palmer*, Mr. *H. H. Price*, and Dr. *Lardner*, in relation to the most judicious Grades for a Railroad. There appears to be but one opinion amongst them on the subject, which cannot be better expressed than in the language of Mr. Vignoles, in reply to the question, "Do you prefer the course of concentrating the inclination?" which is as follows, viz. "it is far better to keep the line as flat as possible, for a great length of time, and concentrate your power by having a stationary Engine, or an assistant Engine, to overcome it,"—(the inclination.)

We annex some remarks on the *London and Brighton* Railway, together with a table of Gradients of Mr. *Gibbs* and Mr. *Stephenson*, which differ materially in the distribution of the Grades.

We are indebted to Mr. G. Ralston, of Philadelphia, now in London, for these and other favors, for which he will please accept our thanks.

Remarks on the two proposed lines of Railway to Brighton.

Two lines of Railway to connect Brighton with London have been proposed separately by Mr. Gibbs and Mr. Stephenson.

Mr. Gibbs' line terminates at one point in London by the Croydon Railway, and at another by means of the Southampton Railway; Mr. Stephenson has subsequently, in his proposal for a Brighton Railway, fixed upon nearly the whole of Mr. Gibbs' line, but has adopted a different principle in planning his gradients.

The grand point of difference in the two lines is, that the gradients of the one, namely, Mr. Stephenson's, have the several rises and falls distributed over their whole length, whereas Mr. Gibbs has concentrated the rises and falls on *his* line in a few points, in order to obtain throughout the rest of the line either levels, or planes of such slight inclination, that practically speaking, they may be considered level.

The following table of the gradients on the two lines, will show that Mr. Gibbs has almost entirely confined his ascents and descents to three short planes, while Mr. Stephenson has distributed nearly the whole of his over 33 miles, with an inclination of 1 in 330.

Table of Gradients.

MR. GIBBS' LINE.

Miles.	Chains.		Feet per Mile.	
11	56	Level.		
3	10	1 in 1002	5	3
6	18	1 in 1188	4	4
5	0	1 in 1028	5	2
3	36	1 in 114	46	3
2	31	1 in 107	49	4
5	5	1 in 2138	2	6
2	31	1 in 111	47	8
8	0	1 in 1289	4	9

MR. STEPHENSON'S LINE.

Miles.		Feet per Mile.	
15	1 in 1100	4	9
5½	550	11	7
33	330	16	0

It is well known to all those who have attended to the progress of Railways in this country, that the question as to what description of gradient is best adapted for the transit on Railways, has excited the most anxious interest in the scientific world and amongst Engineers.

Accordingly we find that the Committee of the House of Lords on the Great Western Railway Bill, has received important evidence from various Engineers upon this amongst other topics which engaged their attention.

From the evidence adduced before this Committee, the following extracts are taken.

It is unnecessary to comment upon these extracts, which contain the recorded opinions of some of the most eminent Engineers in this country, and their opinions are of so recent a date that they must be supposed to express the result of their matured judgment and experience up to the present time.

Mr. George Stephenson in evidence on the Great Western Railway Bill. July 1st, 1835.

Question. With the exception of the Box Tunnel, you know of no Railroad of such an extent with such advantageous levels?

Answer. I do not.

Question. With reference to the inclination of the Box Tunnel, in your judgment, is it advisable to select a point where, by making a steeper inclination upon a short line, you can regulate the rest of the levels upon the line advantageously?

Answer. It is always the plan I have adopted in all the works I have been concerned in.

Question. Was that the reason you adopted the short plane on the Liverpool of a mile and a half, where you have one in ninety-six on the one side, and one in ninety-eight on the other?

Answer. It is about ninety on the other.

Question. Did you select those inclinations in preference to spreading it over a larger surface of your Railway?

Answer. I did.

State your reasons for doing it.

Answer. To allow the engines to bring the heaviest loads possible to the bottom of the inclined plane, by having an assistant engine to get up the load; but if I had distributed that inclination over a longer length, the engine could not have got up that long incline, and it is too long to have an assistant engine.

Mr. George Stephenson. July 2nd, 1835.

Question. Is not the expense of the repair of the engines very much in proportion to the gradients upon the line?

Answer. It is.

Question. And the difficulties they have to overcome?

Answer. Yes.

Question. And therefore you think it better to have a steeper rise at one place, to be worked by a supplementary engine, or a fixed engine, than to give worse gradients throughout the line?

Answer. That is my opinion.

Mr. Vignoles in evidence on the Great Western Railway Bill. July 13th, 1835.

Question. Is 1 in 107 a very bad plane?

Answer. No; it appears scarcely a rise to the eye of a common observer; it is a plane that requires great additional power, and it is better to concentrate the power in

one spot than expend it upon long inclinations over a greater space of ground.

Question. Do you prefer that course of concentrating the inclination?

Answer. Most undoubtedly; it is far better to keep the line as flat as possible for a great length of time, and concentrate your power by having a stationary engine, or an assistant engine to overcome it.

Copy of a Report by Messrs. Stephenson and Palmer.

"To the Directors of the Great Western Railway Company:

"Gentlemen,—In reply to your inquiry relative to our investigation of the proposed line of Railway between London and Bristol, in which you particularly refer to the practical construction of the work, and the working of it by locomotive engines when completed, and whether Mr. Brunel had taken our opinion before he made the selection between the two inclinations at Box; we beg to state that we have examined the whole of the important parts of the proposed line, and consider it judiciously selected, not only as regards the execution, but also the working of the line when executed: and that Mr. Brunel did take our opinions upon the two planes at Box.

"Our advice to him was that he should select the shorter and steeper, as by concentrating the rise in one point, with a practicable length for working either by stationary or assistant locomotive engines, he reduced all the remaining inclinations upon the line to the present favorable amount. And we beg in addition to this to state, that many lines with planes of similar or greater length have been executed, and are now working efficiently, and that no difficulties in the execution of the work can be anticipated.

"The levels of your proposed line are undoubtedly superior to those of the Southampton, or the Basing and Bath, or of any other extensive line with which we are acquainted, and are therefore better adapted to the working of the locomotive engines, both as regards economy and expedition.

"We are, gentlemen,
"Your obedient servants,
"George Stephenson,
"Henry R. Palmer.

"London, March 31st, 1835."

Mr. R. Stephenson in evidence on the Great Western Railway Bill. July 8th, 1835.

Question. Is there more than one way of working a Stationary Engine?

Answer. Yes.

Question. Are those different methods attended with difficulty?

Answer. No; I have seen them all act very efficiently.

Question. I do not know whether you remember the alternative suggested, instead of that Box Tunnel, with a rise of 1 in 107 for two miles and a half?

Answer. Yes.

Question. It was 1 in 333 for nine miles?

Answer. About that.

Question. Which do you prefer?

Answer. I prefer the concentration of the inclination.

Question. What do you gain by the concentration of the inclination?

Answer. You apply a fixed Engine to that to which it is more applicable, and it is more economical upon that inclination; and you make the *remainder of the distance extremely favorable for the operation* of Locomotive Engines.

Question. What do you gain by it in point of power?

Answer. Very great economy of power, and you save a great deal of wear and tear in the Railway.

Question. Where the proportion of that inclination is two miles and a half, and the rest of the line such as you have described it, do you gain in point of speed also?

Answer. Yes; but the principal saving is economy.

Mr. R. Stephenson in evidence on the Great Western Railway Bill. July 10th, 1835.

Question. Have you any knowledge of the Tunnel at Box Hill, except what you have derived from Mr. Brunel?

Answer. As to the cost of making the Tunnel I cannot give an opinion.

Question. Do you know any thing of the country at that spot, so as to judge of the expediency of making a tunnel or not?

Answer. No; I treat it as an abstract question.

Question. Tell me the *data upon* which you proceed?

Answer. In preference to an inclination of six or eight miles at sixteen feet in a mile, I prefer a Tunnel; but I would not make a Tunnel in other cases to avoid an inclination; it is made here to enable the common engine to accomplish the journey upon the rest of the line.

Mr. H. H. Price in evidence on the Great Western Railway Bill. July 7th, 1835.

Question. With reference to the Box Tunnel, do you approve of the method we have heard so much of, namely, the con-

centration of the steepest inclination upon one spot?

Answer. Yes; I stated that opinion to Mr. Brunel when I first met him at Stroud, after the plans were deposited.

Question. That is not an opinion you have taken up lately?

Answer. No.

Question. What is the advantage gained by that concentration?

Answer. That you may apply assistant power to overcome the elevation of the country at one point, instead of spreading it over a greater space of the line.

Question. What is the result if you do not apply assistant power?

Answer. They carry lighter loads, or they go at a smaller speed.

Question. Or—is there not another alternative?

Answer. You may have a fixed engine.

Dr. Lardner in evidence on the Great Western Railway Bill. August 6th, 1835.

The artifice used in forming the Great Western Line (and a very good one it is) consists in concentrating the greatest rise in both directions upon one spot, and by that means obtaining a more uniform level, and so far as that goes it is a great advantage.

Mr. R. Stephenson in evidence on the Southampton Railway Bill. June 25th, 1834.

Question. Is it an object also to get the best levels that can be got?

Answer. Of course it is.

Question. If the level in such a Railroad as this, is such, that there are fifteen miles in going up to the summit of 1 in 300, would you consider that as an inconvenient rise, if you could avoid it?

Answer. If I could avoid it, certainly.

Question. Would you prefer lessening the inclination, and having a short part where the inclination should be so much greater as to require the assistance of an Engine.

Answer. I think I would prefer a short piece.

Question. Upon the Liverpool and Manchester you have two inclinations of one in eighty-six and one in ninety-six?

Answer. Yes.

Question. Was that mode of construction adopted with a view of enabling the engines to act with all their full power up to the rest of the line, and to have the assistance of stationary engines at that point?

Answer. That was the object.

Question. I believe you consider that an inclination of 1 in 240 diminishes half the power?

Answer. Yes, thereabouts: it has been taken at 300, but I think 1 in 240 is more correct.

Question. Should you consider it desirable to construct a line of Railroad with fifteen miles with an inclination of 1 in 300, or should you prefer a shorter length of a steeper inclination?

Answer. I should prefer the short inclination, if the other levels that were obtained by that means were good levels.

Question. If by making a steep inclination for a short distance of two or three miles, you could lessen the inclinations upon the general line, so as to enable the locomotives to carry a weight nearly to the extent of their power, you would consider that a preferable mode?

Answer. Yes, I would; it is impossible to give a general answer to that question; I should be guided by the circumstances of the case.

Question. Supposing you could form a line in which you might go with an inclination, where instead of diminishing the power of the engines one half, it was not diminished one quarter, but when they arrive at a particular point, they might require the assistance of another engine, because it diminished the power two-thirds, would you prefer the line upon which the diminution of the power of two-thirds was only for a short distance, and where the rest of the line gave three-fourths of the power?

Answer. I think I would.

Question. (By a Lord)—Might not there be other circumstances which would render the other line the best?

Answer. I merely speak as an Engineer generally upon the subject. I cannot at all speak as to any local difficulties that may arise; speaking as an Engineer, I would prefer a long line, upon which an engine could operate to its full power with a short inclination when an assistant engine was wanted.

☞ It is with real pleasure that we lay before our readers the following statement in relation to a gentleman, a *practical* mechanic, whose merits are, nevertheless, duly appreciated by the learned gentlemen who preside over one of our most respectable and flourishing Colleges.

To confer, in this instance, is as truly honorable as to receive; and it is an evidence—of which we hope to see many similar instances—that *true merit*, even when found in the work-shop, will find its proper station amongst intelligent and virtuous men.

It is, indeed, a misfortune that there have been so few instances in which laboring men, although possessing talent of the first order, have had the opportunity in early life to acquire the necessary taste for study and learning; and the firmness in middle age, when the cares and perplexity of business engross their attention, to devote their leisure moments to such reading as will naturally lead them to merit such a mark of distinction, from such an institution, as that recorded in the following paragraph from the Albany Evening Journal. It is not that laboring men, or mechanics, are naturally less talented than men of wealth; nor would they be, as a body of men, less competent than men of wealth, to acquire similar marks of distinction, if they possessed in childhood and youth, the opportunity of acquiring a taste and habit for study.

It will hardly be asserted, we imagine, that a greater number in *proportion*, of the wealthy than of the poor, would become learned and wise, if all enjoyed similar advantages. It is a truth, which requires no proof, that the man, who, from the humble and obscure walks of life, becomes distinguished for learning, virtue, and moral worth, gives evidence of more talent, and more merit, and is entitled to greater respect, than a man enjoying all the advantages of early instruction, and intelligent *society*, which is afforded in *almost* all cases by the possession of wealth. It will not, therefore, we apprehend, be denied, that the gentleman, who is the object of this, not only honorary, but *honorable*, A. M., who has probably earned it by a *constant*, and judicious devotion of those hours of *leisure* to reading and intense study, (which, by many of the journeymen and apprentices of *his*, as well as most other trades, and laborious callings, are *too* often spent in idleness, vice, or *dissipation*,) is entitled to great praise and commendation; nor that his example is worthy of universal adoption by young men.

It could only be by this, above all praise, honorable mode of spending his hours of relaxation from labor, that constant and unremitting daily labor to which every man, who has a family to support, without a fortune, must submit, that he could have qualified himself to merit, and if a modest man, to receive such a notice from such an institution.

The Evening Journal says:—

"At the late Union College commencement, the Honorary degree of A. M. was conferred upon John Patterson, of this city, a Journeyman Printer, whose mathematical attainments richly entitled him to that distinction. Mr. Patterson, who served his apprenticeship at Buffalo, came to this city some twelve years ago, where he has sinced worked, and is still working as a journeyman. He is now one of the best practical printers in the Union. By devoting those hours which most of us idle away, to severe study, Mr. Patterson has not only stored his mind with useful general information, but acquired a knowledge of Mathematics which has won for him a Degree from one of the most reputable Colleges in the Union. In addition to all this, with a family to support from his earnings, Mr. Patterson has garnered up about $3000, the fruits of patient toil and economy.—Such an instance of industry and frugality, combined with high intellectual aspirations, is worthy of the palmy days of Rittenhouse and Franklin."

In addition to the above, we find in the Buffalo Journal, the following highly honorable compliment, which establishes beyond question, the real worth and sterling merits of this gentleman.

Few men, very few indeed, who establish whilst *apprentices* such a character, and carry with them into after life the affection of their teachers and masters, fail to become, not only respectable, but honorable members of society.

The Editor of the Buffalo Journal says:

"We copy from the *Albany* Evening Journal the preceding extract, with the simple remark, that Mr. Patterson, the recipient of the College honor, was an apprentice to the proprietor of this paper, and one of the most industrious and praiseworthy young men we ever knew. At his advancement, both in wealth and honors, none more heartily rejoice than ourselves."

Who would not prefer *such* an enviable distinction, to that of being, what so many, at this day, called *honorable* men, strive to be, *leading* and *prominent politicians?* Who, we ask, would not rather be *thus* complimented by those who best know their worth;

and by honest industry merit such a mark of distinction from such an Institution, than to see "HON." attached to his name, in consequence of being selected—by whom?—not by the mass of intelligence in the community; but, in *most* cases, by a *few* men who, at least *expect*, if they have not been *promised*, some *office* or *station* of honor, or profit, for their *dis*interested services in thus making him an *honorable* man? Reader, are we not right when we say, that there is more real merit in being an HONEST, than, when *thus* acquired, in being an *honorable* man?

Who, permit me now to ask, that devotes his early life to habits of industry and study; who that acquires habits of reading, of deep thought, and of serious reflection when young; and devotes his leisure hours, in middle life, in a proper manner, may not look forward with confidence, nay, with almost certainty, to similar marks of distinction, and to equal respect? No youth, however, need anticipate such a result, who is not attentive to the wishes of his employer; honest, industrious, virtuous, and studious; but with these traits of character and ordinary prosperity, every one may obtain them.

Permit me, then, young men, to urge you *onward* in habits of industi yand economy; and studious devotion of your leisure hours to books—books of real utility and not ot fancy—then may you, in after life, also be honored with an A. M.

The following excellent article in relation to "Apprentices' Libraries," and the manner in which *apprentices* ought to spend their leisure time, is from the Buffalo Commercial Advertiser. It contains advice which, if duly appreciated, will be the means of making many a wise, happy, and affluent mechanic, in that "City of the Lakes," which but a few, say *twenty* years since, had *scarcely a mechanic to boast of*; whilst it now numbers its — thousand inhabitants, and will soon vie with many of the Atlantic cities.

APPRENTICES' LIBRARY.—As the long winter evenings are approaching, when time and business afford an opportunity for improvement in the intellectual resources of the numerous apprentices of our city, we would call their attention to the Society which has been established for their especial benefit. By the liberality of our citizens, a respectable library has been collected, which, were its benefits properly appreciated, would effect a great change in the moral and intellectual condition of many apprentices who are wasting their time in worse than useless amusements, which have a tendency to vitiate their habits and ruin their characters. Let them but employ the moments now dissipated in idleness, in the reading and discussion of works of a practical character, and they would acquire a fund of useful information, which, in after life, would be of incalculable worth in all their relations with the world. Youth is the time — the only time — which may be properly set apart for this object; and if it be squandered with impunity, in future years, lasting regret will come over the improvident, and they will in vain recall to their minds the many opportunities lost, which might have advanced their happiness and their respectability among their fellow men. In a city like ours, a thousand attractions present themselves to the young, and if they give way to the indulgence of their curiosity in one point, they may in another, until wholly absorbed in the gratification of present propensities, without once thinking of the future, or the results which flow from an early compliance with their own inclinations or the entreaties of others. Let them adopt the principle of *total abstinence* from all *useless* amusements, and only indulge in those from which some practical good will result, and a mighty change would be wrought among them, which would be felt throughout the mechanical portion of community.

THE ART OF PRINTING.—The folllowing article, in relation to the discovery and progress of the art of printing, cannot but be interesting to most of our readers.

According to it, it is 405 years since the art of printing was first discovered—the progress of the art was, however, almost imperceptible for nearly a century—and even until within the last fifty years its progress was very gradual.

At the present time, however, it would seem to be making rapid strides. *Ten years ago*, 24 to 2,800 pages per hour, of this Magazine, would have been a great day's work for a man and boy—whereas, with the present facilities and improvements, we can

now print, with one man and *two* boys, 24 to 32 *thousand* pages in the same time, with much less labor and fatigue.

We shall, at an early period, give a more minute description of the improvements by which this wonderful performance is effected. At present we will merely observe, that it is done on a registring machine, which prints *both* sides of the sheet before it leaves the press, and which is driven by a *Rotary Steam Engine*, which makes more than *five thousand revolutions per minute!*

The Art of Printing.—On the tenth and eleventh days of July, it is customary at Haarlem, occasionally to celebrate a festival in commemoration of the invention of typographical printing: alledged to have been made by John Lawrens Koster of that place in the year 1430. Although it is certain that the Chinese and Japanese, about a thousand years before the Christian era, understood and practised the art of printing from carved wooden tables, (called technically xylograhic printing,) yet it is equally certain that the Europeans had no knowledge of the existence of this art among the Chinese and Japanese until the beginning of the sixteenth century. It was not until about the year 1498, that Vasco de Gama discovered the route to the East Indies by sea; and it was from the navigators who succeeded him, that the first correct ideas of the state of the arts in China were obtained.

The honor of having given birth to typographical printing, or printing with *moveable* types, is claimed by three cities, Haarlem, Strasburgh and Mentz. It is perhaps not very material to decide between them. The Dutch consider the question proved beyond dispute in favor of Koster. Many of Koster's impressions have been discovered, and are now to be seen: and Scheltema and Konings, have, it is thought, shown conclusively, as late as 1823, that these impressions were made with *moveable types*.

It is now 405 years since Koster's genius produced this useful art. What wonders has it not already accomplished, and does it not promise to accomplish! The press has been called, and not inaptly, "the lever which moves the world." What revolutions in the political and moral world have not been effected by it! With it is intimately connected, and to it do the free of all nations, in a greater or less degree, owe the liberties and privileges they enjoy. The rich legacy left by John Lawrens Koster has descended not only to the Hollanders, but to the inhabitants of the whole civilized world! civilized, did we say; nay, even the uncivilized nations of the earth are beginning to reap its benefits.

We copy the following remarks from a little work on the fine and useful arts, lately published by M. S. Perry, M. D. We think they will prove interesting to those of our readers who are not acquainted with the facts here detailed. "Koster, called also Lawrentius, went to walk in a wood near the city, as was the custom of the opulent class; once, when there, he began to cut some letters upon the rind of a beach tree, which for fancy's sake he afterwards set and arranged in order, and put the words upon paper with their *heels* up, and so impressed and printed on paper one or two copies, as specimens for his grandchildren to follow in writing. This having happily succeeded, he meditated greater things, as he was a man of ingenuity and judgment; and, first of all, he invented, with his son-in-law Thomas Pieter, a more glutinous ink, because he found the common *ink would sink* and spread. *And then he formed whole pages* of wood, with letters cut upon them. Laurentius was a man of fortune, and held a lucrative office under government. He commenced printing with wooden blocks or plates, on which he engraved or carved the words for several small volumes. He employed several workmen, among whom were John Geinsfleiche. Geinsfleiche communicated the art to his younger brother, named Gutenberg, an ingenious mechanic, who lived at Strasburgh. After having stolen a part of his master's apparatus, Geinsfleiche went to Mentz, his native place, and commenced printing about the year 1440. He was assisted with money at first by John Fust, Faust, or Faustus; and afterwards he entered into partnership with him and his brother Gutenberg.

The two brothers united their endeavors to invent a font of metal types with cut faces; they succeeded after many years, and in 1450 a part of the Bible appeared from their press. The partnership between the brothers and Faust was dissolved in 1455. Faust continued the business, and took one of his servants, Peter Schoeffer, into partnership. In 1556, Schoeffer *completed the* invention of metallic types by casting them with faces; he likewise cut matrices for the whole alphabet, with which Faust was so much pleased that he gave him his only daughter in marriage.

The story of the Devil and Dr. Faustus originated from the following circumstance. Faust had printed a beautiful edition of the Bible, which was an exact imitation of the best manuscript. He took a number and went to Paris, where he at first sold them for six and then for five hundred crowns each. At last he lowered his price to thirty crowns each, and all Paris was perplexed at the number of copies produced, and their exact uniformity. They accordingly believed

that Faust had made a league with the Devil, and he was accused of being a magician.

A knowledge of the art was soon obtained in Rome, and the Roman type was introduced in 1467.

In the reign of Henry the Sixth, R. Tourneur and William Caxton went to Haarlem to learn the art. These gentlemen persuaded Corsellis, an under workman, to go to England, and a press was set up at Oxford in the year 1471. The first book printed in the English language was the History of Troy, translated from the French by William Caxton. Ireland was one of the last European countries into which the art of printing was introduced; the first work executed there was in 1551. Printing was practised in Mexico about the year 1569.—The first printing press in the United States was established by Stephen Daye, at Cambridge, in 1639; William Bradford commenced printing in Philadelphia in 1687."

Mechanical Lectures.—It is of vast importance to the rising generation of mechanics that they should enjoy the advantages of Mechanical and Scientific Lectures. One of the objects of this work has been, and is, to contribute to the instruction of those young men, who, like its publisher and editor, commenced their career as an *apprentice*, and rely upon their own hands for success in life; and therefore we take a deep interest in the extension of such advantages to young mechanics generally, as will enable them to become intelligent, virtuous, and worthy members of society, and an honor to the mechanics of our country.

Entertaining these views, and feeling it to be the duty of every community to encourage, and aid, the young men amongst them who desire instruction, we were surprised to see a notice in the New-Jersey Freeman, published at Elizabethtown, N. J., of which the following is an extract:

"The Committee of the Young Men's Mechanic Philosophical Class give notice to its members that the Lecture expected on Tuesday evening will not be delivered.—They regret to be compelled also to inform the class, that a suspension of the Rev. J. T. Halsey's course of Lectures is rendered necessary, because of their inability to procure a convenient room sufficiently large to accommodate all who wish to attend. The room in which the meeting of the class have heretofore been holden will not contain more than a third part of the young mechanics desirous of attending this course, and an application for the only suitable room in the town has been unsuccessful. The Committee would take this opportunity of publicly expressing their thanks for the generous offer of the Lecture Room belonging to the Second Pres. Church, which, however, on account of many objections to the occupation of that place for such a purpose, they thought it adviseable to decline. They, nevertheless, confidently indulge the hope, that the liberality of an enlightened public and particularly of those gentlemen who feel a lively concern for the improvement and welfare of the young men of Elizabethtown, will not suffer the "Young Men's M. P. Class," comprising over a hundred of the young mechanics of the town, to be deprived of the benefit of the course of Lectures which Mr. Halsey has kindly offered to give gratuitously, for the want of a proper and a comfortable place in which to assemble.

Fenwick T. Williams,
Moses H. Ogden,
William S. Thompson,
Mahlon Mulford,
Committee."

We indulge the hope that these young men will not be deprived of the benefit of the liberal offer of the Rev. Gentleman; and that the citizens of Elizabethtown will speedily provide a suitable, and convenient, room for their accommodation.

We would also say a word to the young gentlemen in whose behalf we have written these remarks—yet, as nothing of our own could be more to the purpose, we recommend to their especial notice the maxims which we publish in another part of this number, more especially the three first.

The Cretan Sarcophagus.—A magnificent sarcophagus was discovered last year in Crete, by Sir Pulteney Malcolm, who patriotically brought it to England, we hear, to present it to the University of Cambridge. It is of Parian marble, and more than seven feet long, and in fine preservation. It was found in a small plain, near a village called Ayo Vasile, seven or eight miles from Viano, and though broken into many pieces, the whole has been ingeniously united under the direction of Chantrey, in whose studio it may be seen by all who are curious in antique sculpture. The ends, as well as front of the sarcophagus, including the cover or lid, are entirely sculptured. The subject is the triumphant return of Bac-

chus from India; and though it seems to have little connection with death and the grave, it must be borne in mind, that the god was born in the isle, and that the Cretans invented the orgies in his honor. The figures are in high relief: a naked youth, stooping under a wine skin, accompanied by a musician, leads the procession; an elephant follows, with three girls on its back, playing on the double pipe and cymbals; Silenus, sufficiently intoxicated, is borne after by two youths, who seem not unconscious of the weight, while a satyr follows, striking a tambourine, and actually leaping into the air with delight. A male and female centaur succeed; 'one seems woman to the waist, and fair, but ending foul,' the other has his brows bound in vine leaves, and seems in a passion, which his female companion tries to soothe, by throwing her arm round his neck; an empty cup, depending from her fingers, intimating that wine has something to do with the wrath which agitates him; this is more distinctly intimated by the action of the closing group. Bacchus appears—all youth and beauty—grave rather than joyous—in a splendid car, on a panel of which a youth and satyr are contending; the right hand of the god elevates a trophy, while the left hand protects a trembling fawn, his companion in the car, at whom the angry centaur seems in the act of throwing a wine cup. The fear of the one, and the surly wrath of the other, are well expressed. Two men on one end of the sarcophagus seem disputing about a child, which they are bearing away in a basket; while on the other end two cupids are engaged in an attempt to put a tipsy satyr to bed; drapery is suspended between two trees; the urchins have their friend on their shoulders, and are striving, on tiptoe, to heave him up, while a quiet smile is playing over the brows and in the corners of his mouth, at their fruitless endeavors. All this seems more akin to luxurious painting than to the simplicity and gravity of sculpture. The relief wrought on the lid, is of a still more joyous character.—[Scientific Tracts.]

ELECTRICITY.

Dr. Smith—Dear Sir,—You have my grateful acknowledgments for an interesting number of your Scientific Tracts. I regret to learn that you were disappointed in the trial of some experiments which I communicated to you concerning the motion of camphor on the surface of liquids. I have repeated them several times with the same results.

Will you accept a few observations from my journal (of 1830) on the subject of Electricity.

Penetrability of Electric Light.

If a piece of sugar, a potato, or an egg, be included in the circuit of a Leyden jar, whenever a discharge takes place, a beautiful illumination is produced. A decanter of water, or the finger, may be strongly illuminated by the light from a battery or large jar. But by far the most brilliant illumination which I have ever seen from the electric light, may be produced by passing simply the spark from the prime conductor through the dried pith of corn-stalk. A sound piece of corn-stalk should be selected, the pith carefully cut out and thoroughly dried, and it is fit for use. The length of the piece of pith should be the same as that of a spark taken from the ball of the conductor. Whenever a spark is passed through the pith, a perfect, intense yellow light pervades its whole substance. Frequently red and yellow lights are produced together, and sometimes violet. This experiment will richly repay any operator for his trouble. It must be recollected, that unless the pith be thoroughly dried, the illumination will not be produced, as the electricity will pass by conduction.

Electrical Property of Copal.

I have frequently observed, while polishing pieces of copal, containing insects, that it became strongly electrical, and have been induced by this to make further trial of its value as an electric. The best form of this substance for experiment I found to be the dried copal varnish. On varnishing a large glass rod, and rubbing it with a piece of amalgamated silk, the quantity of electricity developed was immense, far exceeding that produced by the unvarnished glass. I then varnished the cylinder of my electrical machine, and the result surpassed my expectations. The machine furnished

treble its usual quantity of electricity, and this continued for some months, when it began to abate its action. I found the varnish had become scratched by the crystallized portions of amalgam, and was obliged to scrape the varnish entirely from the cylinder. It remains, then, for some one to point out a method by which the friction of the rubber and cylinder may be diminished, with the pressure remaining the same, to make this improvement complete.*

If you think these facts are worthy of a place in your Tracts, you may embody them in whatever form you please.

Yours truly,

CHARLES G. PAGE.

Salem, September 26, 1835.

* The varnish should be very hard and dry before it is used.

METHOD OF WORKING HORN.

Horn, particularly of oxen, cows, goats, and sheep, is a substance soft, tough, semitransparent, and susceptible of being cut and pressed into a variety of forms; it is this property that distinguishes it from bone. Turtle or tortoise shell seems to be of a nature similar to horn, but, instead of an uniform color, it is variegated with spots. These valuable properties being known, render horn susceptible of being employed in a variety of works fit for the turner, comb and snuff-box maker. The means of softening the horn need not be described, as it is well known to be by warmth; but an account of the cutting, polishing, and soldering it, so as to make plates of large dimensions, suitable to form a variety of articles, may be desirable. The kind of horn most to be preferred is that of goats and sheep, from its being whiter and more transparent than the horn of any other animals. When horn is wanted in sheets or plates, it must be steeped in water, to be able to separate the pith from the kernel, for about fifteen days in summer, and a month in winter; and when it is soaked, it must be taken out by one end, and well shook and rubbed, in order to get off the pith, after which it must be put for half an hour into boiling water, and then taken out and the surface sawed even lengthways. It must again be put into the boiling water to soften it, so as to render it capable of separating; then, with the help of a small chisel, it can be divided into sheets or leaves. The thick pieces will form three leaves; those which are thin will form only two, while young horn, which is only one quarter of an inch thick, will form only one. These plates or leaves must again be put into the boiling water, and when they are sufficently soft, they must be well worked with a sharp cutting instrument, to render those parts that are thick, even and uniform. It must be put once more into the boiling water, and then carried to the press.

At the bottom of the press employed there must be a strong block, in which is formed a cavity of nine inches square, and of a proportionate depth; the sheets of horn are to be laid within this cavity in the following manner, at the bottom:—First a sheet of hot iron, upon this a sheet of horn, then again a sheet of hot iron, and so on, taking care to place at the top a plate of iron, even with the last; and the press must then be screwed down tight.

There is a more expeditious process, at least in part, for reducing the horn into sheets, when it is wanted very even. After having sawed it with a very fine and sharp saw, the pieces must be put into a copper used for the purpose, and there boiled until sufficiently soft, so as to be able to split with pincers: then bring quickly the sheets of horn to the press, where they are to be placed in a strong vice, the chaps of which are of iron, and larger than the sheets of horn, and screw the vice as quick and tight as possible; let it then cool in the press or vice; or it is as well to plunge the whole into cold water. The last mode is preferable, because the horn does not dry up in cooling. Now draw out the leaves of horn, and introduce other horn to undergo the same process. The horn so enlarged in pressing is to be submitted to the action of the saw, which ought to be set in an iron frame if the horn is wanted to be cut with advantage, in sheets of any desired thickness, which cannot be done without adopting this mode. The thin sheets thus produced must be kept constantly very warm, between plates of hot iron, to preserve their softness. Every leaf must be loaded with a weight heavy enough to prevent its warping. To join the edges

of these pieces of horn together, it is necessary to provide strong iron moulds suited to the shape of the article wanted, and to place the pieces in contact with copper plates, or with polished metal surfaces against them; when this is done, the whole is to be put into a vice and screwed up tight, then plunged into boiling water, and after some time, it is to be removed from thence, and immersed in cold water, which will cause the edges of the horn to cement together, and become perfectly united.

To complete the polish of the horn, the surface must be rubbed with the subnitrate of bismuth by the palm of the hand. The process is short, and has this advantage, that it makes the horn dry promptly.

When it is wished to spot the horn in imitation of tortoise shell, metallic solution must be employed, as follows:—To spot it red, a solution of gold in aqua regia must be employed; to spot it black, a solution of silver in nitric acid must be used; and for brown, a hot solution of mercury in the nitric acid. The right side of the horn must be impregnated with these solutions, and they will assume the colors intended. The brown spots can be produced on the horn by means of a paste made of red lead, with a solution of potash, which must be put in pieces on the horn, and subjected some time to the action of heat. The deepness of the brown shades depends upon the quantity of potash used in the paste, and the length of time the mixture lays on the horn. A decoction of Brazil wood, a solution of indigo, with sulphuric acid, a decoction of saffron, and Barbary tree wood, is sometimes used. After having employed these materials, the horn may be left for half a day in a strong solution of vinegar and alum.

In France, Holland, and Austria, the comb-makers and horn-turners use the clippings of horn, which are of a whitish yellow, and tortoise shell skins, out of which they make snuff-boxes, powder-horns, and many curious and handsome things. They first soften the horn and shell in boiling water, so as to be able to submit them to the press in iron moulds, and by the means of heat, form it into one mass. The degree of heat necessary to join the horn clippings must be stronger than that for shell skins, and which can only be attained by experience: the heat must not be too great, for fear of scorching the horn or shell. Considerable care is required in these operations not to touch the horn with the fingers, nor with any greasy body, because the grease will prevent its joining perfectly. Wooden instruments should be used to move them while they are at the fire, and for carrying them to the moulds.—[Scientific Tracts.]

The City of Dort, in Holland, preserved by Milkmaids.—During the wars in the Low Countries, the Spaniards intended to besiege the City of Dort, in Holland, and accordingly planted some thousands of soldiers in ambush, to be ready for the attack when opportunity might offer. On the confines of the city lived a rich farmer, who kept a number of cows in his grounds, to furnish the city with butter and milk. His milkmaids, at this time, coming to milk their cows, saw under the hedges the soldiers lying in ambush, but seemed to take no notice; and having milked their cows, went away singing merrily. On coming to their master's house, they told him what they had seen; who, astonished at the relation, took one of the maids with him to a burgomaster at Dort, who immediately sent a spy to ascertain the truth of the story. Finding the report correct, he began to prepare for safety, and instantly sent to the States, who ordered soldiers into the city, and commanded the river to be let in by a certain sluice, which would instantly lay that part of the country under water where the besiegers lay in ambush. This was forthwith done, and a great number of the Spaniards were drowned; the rest, being disappointed in their design, escaped, and the town was thus providentially saved. The States, to commemorate the memory of the merry milkmaids' good service to the country, ordered the farmer a large revenue as a recompense to him for the loss of his house, land, and cattle; and caused the coin of the city to have a milkmaid, milking a cow, to be engraven thereon, which is to be seen at this day upon the Dort dollars, stivers, and doights; and similar figures were also set up on the watergate of Dort: and the milkmaid was allowed for her own life, and her heirs for ever, a very handsome annuity.—[Edinburgh Quarterly Journal of Agriculture.]

Manner of Making Persons Free at Alnwick, in Northumberland.—Those who are to be made free, or, as the phrase

is, *leap the well*, assemble in the market-place, very early in the morning, on the 25th of April, being St. Mark's day. They appear on horseback, dressed in white, with white nightcaps, and every man a sword by his side, attended by the four chamberlains, and the castle-bailiff, mounted and armed in the same manner. They then proceed, with music playing before them, to a large dirty pool, called Freeman's-Well, where they dismount, draw up in a body, then rush in all at once, and scramble through the mud as well as they can. After this they take a dram, put on dry clothes, remount their horses, gallop round the confines of the district, and then re-enter the town, sword in hand, and are met by women, dressed in ribands, with bells and garlands, dancing and singing. These are called Timber-wastes. On this day, the houses of the new freemen are distinguished by a holly-bush, as a signal for their friends to come and make merry with them on their return. This manner of making free is peculiar to Alnwick, according to a clause in the charter given them by King John, who, travelling this way, stuck fast in a hole, and thus punished the town, for neglecting to mend the roads.—[Ib.]

A BRIEF ADDRESS TO YOUNG MEN.

The following breif address to the young men of our country is taken from the first or specimen number of the Cultivator. It is worthy of a repeated perusal by every young man, and deserves to be universally practised upon.

"The YOUNG MEN we would specially appeal to. You are destined soon to occupy the stage of public action, and to fill the important stations in society. *Now* is the time to *prepare* for those high duties, as well as for profit and distinction in your business. Your characters are but partially formed, and are yet susceptible of receiving good or bad impressions, which are to last through life. It is important to you, to your friends, and to society, that these impressions should be for good. We will lay before you rules and axamples of the wisest and best men, to aid you in the formation of your characters—to enable you to become intelligent and successful in your business,—useful and respectable in society, —and beloved and happy in your families. Do not object that you have no *time* to read. Few young men labor more hours than did Benjamin Franklin, or are more humble and self-dependent than he was in his youth; and yet Franklin found abundant time for self-instruction; and so indefatigable and successful was he in his studies, that he became one of the most useful and celebrated men of the age. We need not limit the remark to Franklin. Most of the distinguished men of the day have risen from humble stations by their own industry and frugality, and have acquired a great share of their knowledge in the hours not allotted to ordinary business. Your winter evenings are your own, and may be applied usefully. They may be computed at one-fourth of the day, or one entire month in the year. Time is money: and the young man who appropriates this month to the acquiring useful knowledge, does more to add to his future fortune, to say nothing of his intellectual wealth, than if he received pay for this month and loaned it upon interest. Knowledge is in another respect like money: the greater stock of it on hand, the more it will administer to the respectability and enjoyments of life. But knowledge is not to be acquired without exertion, nor is any thing else that is useful in life. It is the labor we bestow in acquiring an object that imparts to it an intrinsic value. It has been well said that, 'although we may be learned by the help of others, we never can be wise but by our own wisdom.' It is the humble design of this monthly sheet to excite a laudable ambition to improve the mind as well as the soil. If we succeed in awakening the latent energies of the former, we think the latter will follow as a natural consequence, and our object will be attained."

We present to our readers, from the Cultivator, No. 2 of the "Letters from a Father to his Son"—and we earnestly recommend them to the notice of every *son* who desires to contribute to the happiness of his parents and friends, and at the same time to promote his own.—*Read and practice!*

EDUCATION.—There are few terms of more indefinite meaning than the one which heads this letter. Some suppose it consists in learning to read, write and cypher; while others contend, that no young man can be deemed educated, or at leat *well* educated, until he has been dubbed *A. M.* at a college, has passed a term at some academy, or has become a licentiate in one of the learned professions. My definition varies from both, and comprises more than either. I define education—*a knowledge of our religious, moral, political, social and relative duties*,—AND THE HABITUAL PERFORMANCE OF THEM. The apprentice, who has merely acquired the names of the tools which belong to a trade, may as well be deemed to have learnt that trade, as the boy to be educated, who has merely obtained school instruction.

The tools are the means by which the apprentice, by attention and industry, is to acquire a knowledge of the trade, and his reputation as a mechanic will depend upon the fidelity and skill with which he employs them. Schooling is to the mental what tools are to the physical powers.—the *means* of becoming useful to one's self, and to society at large;—and in both cases success and distinction are wisely made to depend upon individual exertion. The *boy* may acquire the mechanical art, but the noblest powers of the mind are seldom developed but in *manhood*. Thus you perceive that I consider your education as having but commenced; and that you have yet to learn, by study and reflection, those high duties of manhood which are to have an intimate bearing upon your future happiness and prosperity. Your mind has yet to be disciplined, by reading, observation and reflection, and your habits are yet to be fixed. Practice is as necessary in this as it is in mechanics—it is as necessary to make a fluent orator, or a graceful writer, as it is in cutting well a coat, or shoeing a horse. To stimulate you to the performance of duty, and to deter you from habits of sloth, indolence and vice, I here venture to assure you, as a conviction growing out of half a century's experience and observation,—that the practice of every virtue will bring its reward, in one shape or another—and that indulgence in vice, will as assuredly be followed by some corresponding suffering, in mind or body. We enjoy animalpropensities in common with the brute creation;—but the higher feelings—the moral sentiments,—the pleasures of intellect,—belong peculiarly to man—and man rises in the scale of beings in proportion as he cultivates and improves these peculiar gifts of his Creator.

[From the Cultivator.]

J. Buel, Esq.

Sir,—Permit me to present to your readers a translation of the story of Lucius Quinctius Cincinnatus. In order duly to appreciate the history of this man, whose name after the lapse of centuries has reached even this western world, it is necessary to be able to peruse it in the simple but inimitable language of the great Roman Historian. There is in the original description a beauty and simplicity which are unrivalled. When Rome was distracted by commotions within, and assailed by hostile bands without—when the army commanded by the consul was besieged even within their camp, and dared not go forth to meet the foe, — when all was confusion and dismay, and destruction seemed to threaten even the city itself, Lucius Quinctius Cincinnatus was appointed dictator by the unanimous voice of the people. The affairs, as recorded by Livy, is as follows:

"Let those listen to the story of Cincinnatus, who despise every thing when compared with riches, and who deem the poor neither virtuous or honorable. Lucius Quinctius, the only hope of the Roman empire in the hour of peril, cultivated four acres of land upon the banks of the Tiber. He was there found by the commissioners despatched for this purpose, while engaged in *ploughing*. Having exchanged salutations, they besecched him for his own sake, and from his regard for the Republic, to listen to the commands of the Senate. Amazed, and anxiously inquiring "if all was well," he desires his wife *Racilia* to bring his gown from the cottage with all possible haste. No sooner had he wiped away the dust and sweat, and thrown around him *his garments*, than the ambassadors, with congratulation, *salute him* dictator, and invite him to the city, declaring that the army was overwhelmed with terror. In a ship prepared at the public expense, Quinctius and his three sons are conveyed to Rome: his relatives and friends, and all the nobles, go forth to meet him. Surrounded by an immense multitude, and attended by lictors, he is conducted to his future abode. Having met and overcome the enemy, and restored peace to the city, he resigned the office of dictator at the close of the sixteenth day, although elected for six months, choosing to cultivate his humble farm, and abide in his humble cottage, rather than control the destinies of the Roman people."

Let those who cultivate the soil with their own hands, reflect upon the following facts in the story of Cincinnatus. He was a humble farmer—possessed only *four acres* of land—dwelt in an humble *hut* or cottage — was found by the commissioners actually employed in labor — was covered with dust and sweat, the necessary accompaniments of rural toil; and yet even this man, by the unanimous voice of the people, was placed at the head of the Roman empire, with absolute power over the property and lives of his fellow citizens. Having accomplished the object for which he was elected, he most readily and cheerfully resigns his office, and retires to the shades of private life. The name of Cincinnatus will never die; while simplicity and virtue remain on earth, it will stand emblazoned in characters that "can be seen and read of all men." Oneida.

Vernon, June 21, 1835.

The Mathematical Instinct of Bees.—The operations of pure instinct have never been supposed by any one to

result from reasoning; and certainly they do afford the most striking proofs of an intelligent cause, as well as of a unity of design, in the world. The work of bees is among the most remarkable of all facts in both these respects. The form is in every country the same—the proportions accurately alike—the size the very same, to the fraction of a line, go where you will; and the form is proved to be that which the most refined analysis has enabled mathematicians to discover as, of all others, the best adapted for the purposes of saving room, and work and materials. This discovery was only made about a century ago; nay, the instrument that enabled us to find it out—the *fluxional calculus*—was unknown half a century before that application of its powers. And yet the bee had been for thousands of years, in all countries, unerringly working according to this fixed rule, choosing the same exact angle of 120 degrees for the inclination of the sides of its little room, which every one had for ages known to be the best possible angle, but also choosing the same exact angles of 110 and 70 degrees for the inclinations of the roof, which no one had ever discovered till the 18th century, when Maclaurin solved that most curious problem of *maxima* and *minima*, the means of investigating which had not existed till the century before, when Newton invented the *calculus*, whereby such problems can now be easily worked. —[Lord Brougham's Discourse of Natural Theology.

[From the American Gardener's Magazine.]

The Influence of Flowers. By C. C.

"Are not flowers the stars of earth, and are not stars the flowers of Heaven? Flowers are the teachers of gentle thoughts, the promoters of kindly emotions."

Among the many indications of the advance of our country in taste and refinement, none afford a surer criterion than the increased attention which is given to flowers and fruit. When we notice the many establishments in our vicinity, within a few years, devoted to the improvement of horticulture, we cannot but rejoice at the diffusion of an employment so well adapted to afford much pure and innocent pleasure; and we doubt not the time will soon arrive, when the cultivation of flowers will be pursued as a means of moral and intellectual advancement, as well as a source of exquisite gratification.

Every thing which tends to increase domestic enjoyment, which furnishes to a family that pleasure at home, which otherwise they would be impelled to seek elsewhere, is valuable. There is nothing which adds more to happiness, than for all the members of a family to be united in one common and pleasant pursuit—not that all should have the same daily occupation—but that there should be some sources of pleasure open to all, and to increase which, all should in their turn contribute. No employment, perhaps, can so effectually give this union of purpose, and this sympathy of feeling, as the cultivation of flowers. It opens a wide prospect of enjoyment, with scenes to suit many varying tastes. To the scientific mind, to one who loves to search out causes and effects, to discover the hidden properties and qualities of things, what an interesting and yet almost untrodden field does botany present! Then to one whose heart predominates over the intellect; who delights in sentiment; who prefers deep feeling to lofty thought, a garden yields many exquisite delights. His poetic mind gathers much of its finest imagery, its most beautiful thoughts, from the fragrance and loveliness of flowers, and it is quickened and enlightened by the thoughtful contemplation of their varied graces.

And for humbler purposes, for less exalted natures, the riches of Flora furnish many gratifications. For the morning drawing-room, or for the evening dress, there can be no prettier or more appropriate ornaments than can be found among her stores. And to the affectionate heart, what sweeter tribute can be offered to the invalid mother, or the declining sister, than the first-fruits of the garden, and the first buds of the rose. Even the little child laughs, in the fulness of its happiness, when it is permitted to play with the flowers, and fill its lap with the butter cups and clover blossoms.

And so it is in this one amusement; all ages and all tempers can find an appropriate gratification; all may be made more happy. It ministers, also, to man's moral nature. A green-house, connected, as we sometimes see them, with the most frequented apartments of a family, is, in winter, when the garden is bereft of its beauty, and the orchard has yielded its fruit, an almost unfailing source of interest. To enjoy, when storms are beating without, and the chill of winter speaks in the howling wind, the mild air, the fragrance, and the beauty of this reserved fragment of summer, tends to produce feelings of contentment and satisfaction—feelings which show themselves forth in acts of kindness and words of affection.

Another advantage which the cultivation of flowers affords over other pleasures is, that it can hardly be wrested to evil. Absorbing as it is, it produces no feverish excitement. Bringing the mind into close contact with the loveliest things in nature, it shuts out the vexatious feelings arising from collision with the world. Its pleasures are all calm and tranquil. The contemplation of any of the works of God has a mighty effect in soothing and quieting the tumult of human passions, and this precious power over the heart is freely given, even to the lilies of the field. Where we see a love for these, that is not the place to look for the turbulence of passion, or the debasements of sensuality. When we see by the road-side a cottage, around whose door the sweet-briar and the honey-suckle are climbing, and before which, in its little garden, is displayed even the humbler flowers,—the marygold, the pansy, the aster, and the poppy—how instinctively do we form a favorable opinion of the inhabitants of that cottage; how certain we may be of finding peace, contentment, and affection, inmates here! C. C.

October, 1835.

The Tomato.—Dr. Bennett, the Professor of Midwifery, and the Diseases of Women and Children, Hygeine and Acclimatement, in the Medical College of Lake Erie, which is the Medical Department of the Wiloughby University of Lake Erie, at Chagrin, Cuyahoga Co., Ohio, in his public introductory lecture recently delivered in that flourishing institution, made the following statement relative to the *Solanum Lycopersicum*, or, as it is generally called, tomato, love apple, Jerusalem apple, &c., to wit:

1st. That it (the tomato) is one of the most powerful deobstruents of the Materia Medica, and that in all those affections of the liver, and other organs where calomel is indicated, it is probably the most effective and least harmful remedial agent known to the profession.

2d. That a chemical extract will probably soon be obtained from it which will altogether supercede the use of calomel in the cure of disease.

3d. That he has successfully treated serious diarrhœa with this article alone.

4th. That when used as an article of diet, it is almost a sovereign remedy for dyspepsia, or indigestion.

5th. That persons removing from the east, or north, to the west, or south, should by all means make use of it as an aliment, as it would in that event, save them from the danger attendant upon those violent bilious attacks to which almost all unacclimated persons are liable.

6th. That the citizens in general should make use of it, either raw, cooked, or in form of a catsup, with their daily food, as it is the most healthy article of the Materia Alimentaria, &c.

Now if these positions be true, it is of the utmost importance that the public should be made acquainted with the facts, and it is with this view that I now make this communication for the press.

The Farmer.—*It does one's heart good* to see a merry round-faced farmer. So independent, and yet so free from vanities and pride. So rich, and yet so industrious; so patient and persevering in his calling, and yet so kind, social and obliging. There are a thousand noble traits about him which light up his character. He is generally hospitable—eat and drink with him, and he won't set a mark on you, and sweat it out of you with double compound interest, as some I have known will: you are welcome. He will do you a kindness without expecting a turn by way of compensation: it is not so with every body. He is generally more honest and sincere—less disposed to deal in a low and underhand cunning, than many I could name. He gives to society its best support; is the firmest pillar that supports the edifice of Government; he is the lord of nature. Look at him in his homespun and gray back—gentlemen laugh if you will—but, believe me, he can laugh back if he pleases.

The American Journal of Science and Arts, conducted by Benj. Silliman, M. D. LL. D.—October. New-Haven, H. Maltby and Herrick & Noyes. New-York, G. & C. Carvill & Co.—This number is almost entirely given up to an account of the coal formation of the Ohio and its confluent rivers, by Dr. S. P. Hildreth, of Marietta, Ohio. The mass of information, of curious results, and magnificent realities, embodied in this paper, makes it one of great interest—even to unscientific readers. There are annexed to the account several pages of woodcuts, representing accurately the various fossil remains found in the coal beds, and occasionally portions of the striking scenery amid which these beds are stretched far and wide.

Personally, we read this paper with the more interest from having last Spring passed over a portion of the region described in it, and been struck with the prodigality of nature in her gifts to it. The annexed account will, we are sure, be new, as well as interesting to many of our readers.—[N. Y. Am.]

The Bituminous Coal Fields of Pennsylvania.—Nature, in the disposition of her bounties, seems to have bestowed upon Pennsylvania, more

than a due proportion of the treasures of the mineral kingdom. Great and valuable as are her anthracite deposits, and rich and abundant as are her mines of iron ore and other minerals, her bituminous coal region is still more extensive and inexhaustible. The great secondary deposit, extending, as is generally believed, from the Hudson to the Mississippi, and to the Rocky mountains, is in Pennsylvania limited by the Alleghany mountains, which appear to form the barrier, or dividing line between the anthracite and bituminous coal beds, or between the transition and secondary formations. The union or junction of these formations is plainly and distinctly marked in the end of the mountain, where the west branch of the Susquehanna breaks through it, above Bald Eagle, the latter resting against the former, and forming the basin in which the bituminous coal, in regular and successive strata, is deposited. The coal field is therefore confined to the west side of the Alleghany, and is supposed to extend to the centre of the mountain. In the S. E. corner of Somerset county, and in the western parts of Bedford and Huntingdon counties, it would appear to extend to the S. E. of what is there called the Alleghany, and occurs in great abundance on Wills' creek, Jennings' creek, &c. emptying into the Potomac. The chain of mountains called the Alleghany above Bedford, is very wide; and large mountains diverge from it, and although the mountain ranging through Somerset and dividing the waters of Youghiogana and Connemaugh, from those of the Potomac, may be the largest, it seems most probable that Wells or Evetts, or possibly Sideling mountain, there forms the boundary of these deposits, and upon examination will be found to exhibit a continuation of the same characteristic features between the secondary and transition formation.

The bituminous coal beds, vary from one foot to twelve feet in thickness, but rarely exceed six feet. They lie in nearly horizontal strata, with about sufficient dip to free the mines from water—some hills contain *three and four* beds, with alternate layers of earth and slate, and rest between a firm and smooth slate roof and floor. *Faults* or *troubles* are seldom met with, and in this they differ from the anthracite, and go far to confirm the opinion, that all this vast extent of secondary rocks, was once the bottom of the great lake or sea, and that it suffered little if any interruption from the gradual discharge of its waters, through its distant and widely extended boundary. It has evidently been drained by the Mississippi, the St. Lawrence, the Susquehanna and the Hudson; and it is a curious and interesting fact, that near the northern termination of this coal field, in Potter county, the head waters of the Alleghany, the Susquehanna and the Genesee rivers, flowing into the gulf of Mexico, the Chesapeake and the St. Lawrence, take their rise in an area or space of about five miles.

With the exception of the Susquehanna and its tributaries, and Wills' creek, emptying into the Potomac, all the streams rising in the coal field, west of the mountains, flow into the lakes, or into the Ohio river, and consequently the ground falls off or recedes in the same direction, and becomes too low, as is generally supposed, to contain the coal measures. Its northern termination or boundary may be traced from the head waters of the Towanda creek, in Bradford county, thence across the high lands or dividing waters of Tioga, Potter, McKean, Warren, Venango, &c., to the Ohio State line.—The Tioga river and its tributaries penetrate the coal field in the vicinity of Blossburgh and Wellsborough in Tioga county. A recent and interesting mineralogical report, upon this region, has been made, by R. C. Taylor, a practical engineer and geologist, for the Blossburgh Railroad Company, in which it is satisfactorily shown that the coal runs out as the streams decline to the north.—"There would need," says the report, "a total height of mountains of five thousand, one hundred and twenty feet, at the State line between New York and Pennsylvania, to contain the coal measures, whereas the hills, there, are probably below six hundred feet in altitude. This calculation is entered into with a view of showing the futility of the expectation, not uncommonly expressed, of tracing these coal fields in a northerly direction beyond the limits at which they are at present discoverable."—"This field being bounded on the south by the Alleghany mountain, extending into the State of Virginia, and westward; coal may be said to be present, to a greater or lesser extent, in all the western counties, with the exception of Erie, in which it has not been discovered. The counties of Bradford, Lycoming, Tioga, Potter, McKean, Warren, Crawford, Bedford, Huntingdon and Centre, lie partly in and partly out of the coal field. The counties of Alleghany, Armstrong, Beaver, Butler, Cambria, Clearfield, Fayette, Greene, Indiana, Jefferson, Mercer, Somerset, Venango, Washington and Westmoreland, are wholly within its range, and embrace together an area of *twenty-one thousand* square miles, or *thirteen millions four hundred and forty thousand acres.*" Coal has been used for fuel and manufacturing purposes, west of the mountains, from the earliest settlement of the country. It is mined, to a greater or less extent, in all the above counties, at the rate of one cent and two cents per bushel, and is thus brought within the means of all, and literally to every man's door—abounding throughout all this vast extent of territory, and fitted and used for almost every purpose requiring heat, it is impossible to form any thing like a correct estimate of the quantity consumed yearly, and sent to market. That its great abundance and cheapness have given birth to the vast and widely extended manufacturing establishments of the west, there can be no doubt. Without coal they could not exist. It constitutes the life spring of Western Pennsylvania, and the pedestal of our great manufacturing emporium.—Pittsburgh and its environs contain ninety steam engines for the various manufactures of iron, steel, glass, cotton, salt, brass, white lead, flour, oil, leather, &c. These engines consume two millions sixty-five thousand three hundred and six bushels a year. The city of Pittsburgh and its suburbs, Alleghany town, Birmingham, &c., contain a population of thirty thousand souls. "The coal consumed for every purpose, in and about Pittsburgh, is estimated at seven millions six hundred and sixty-five thousand bushels, or two hundred fifty-five thousand and five hundred tons—at four cents per bushel, the price now paid in Pittsburgh, it would amount to three hundred and six thousand five hundred and twelve dollars." "The coal consumed in the manufacture of salt, in the western counties is very great. There are on the Alleghany, Kiskiminitas, Connemaugh, Crooked creek, Mahoning, Saw mill run, Brush creek, Sewickly, Youghiogany and Monongahela, about ninety salt manufacturing establishments, and many others

about going into operation. These establishments produce yearly about one million bushels of salt, and consume five millions of bushels of coal."— 'The coaking process is now understood, and our bituminous coal is quite as susceptible of this operation, and produces as good coak, as that of Great Britain. It is now used to a considerable extent by our iron manufacturers in Centre county and elsewhere."

These facts, elucidating the immense mineral wealth of the "valley of the Ohio," open to the imagination a long vista of power and greatness, which the utmost stretch of the imagination is hardly able to equal.

The *Cannel Coal* has as yet only been found in the vicinity of Cambridge, Guernsey Co., Ohio, though it is supposed also to exist about the head waters of the Muskingum, considerable masses of it having been picked up on the banks of that river, brought down by the current. We were not before aware that this most brilliant and combustible of coals had been found at all in the United States.

There is a vast amount of information in this paper, to which we would desire to advert, but know not what to select, and therefore confine our extract—having begun with coal—to the subjoined speculation upon

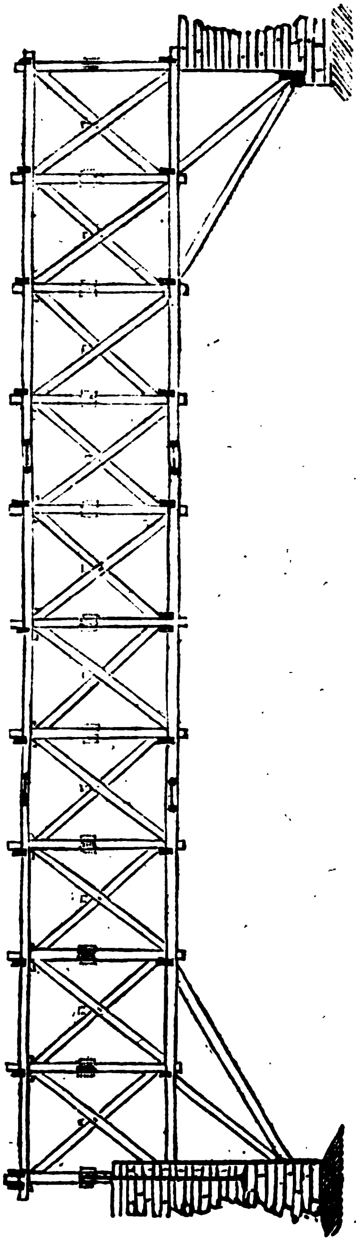
Coal Deposits.—The immense beds of bituminous coal found in the valley of the Ohio, fill the mind with wonder and surprise, as it reflects on the vast forests of arborescent plants required in their formation. Age after age, successive growths of plants, springing up in the same region, were entombed beneath thick strata of shale and sandstone, until the whole series had accumulated to a depth of more than a thousand feet: while beneath the whole, lay the bed of an ancient ocean floored with fossil salt. Indications of coal are found at intervals, across the great valley, from the Allegheny to the Rocky Mountains. It is found near the surface in Kentucky, Ohio, Indiana, Illinois and Missouri, and without doubt, may be found beneath the extensive territory deposits, which form the substratum of the great prairies in the central and northern parts of the Western States. As low down as New Madrid on the Mississippi, coal was thrown up from beneath the bed of the river, by the great earthquakes of 1812—a sufficient proof of its continuation in the most depressed part of the great valley.

That coal is of vegetable origin, no one who has read much on the subject, or personally examined the coal beds, will now deny. Time was, when it was considered a peculiar mineral product, formed in the earth in the same manner and at the same time with the rocks that surround it. The product of its chemical analysis, being altogether vegetable, and the artificial formations of coal from wood by Sir James Hall, have silenced all doubts on the subject. The only mystery now is, how such vast quantities of vegetable matter could be accumulated and grow on the spot where they were buried. That they grew in general, on the surface now occupied by the coal, appears certain from the perfect state in which the most delicate leaves and stems are preserved. Had they been transported by currents of water, and especially from any distance, it is hardly possible that they should not have received more damage. The climate, at that period, must have been both more warm and more humid than at present, as many of the plants are of those families which now grow only in tropical climates; and as the laws of nature never change, this may be deemed a correct inference. A similar climate seems to have prevailed in the latitudes north of 30°, both in Europe and in America, many of the same plants being common to the coal strata of both countries, as will be evident by comparing the drawings of several of the species found in the valley of the Ohio, with those exhibited by M. Brongniart, in his work on "Des Vegetaux Fossiles," of the European coal beds. South of lat. 30°, but few coal deposits are found, the climate requiring but little fuel for the comfort of the inhabitants; but north of that parallel, many districts could be but very thinly inhabited, or perhaps not at all, were it not for the wonderful provision of coal laid up in the bowels of the earth for the use of its inhabitants, after the forests were destroyed to make room for cultivation.

The coal deposits of Britain, by nourishing her manufactures, which have raised her to her present proud attitude among the nations, are the principal sources of her present greatness.

In the valley of the Ohio, some of the coal beds were covered with marine deposit; in others the deposit was made in fresh water, as is demonstrated from the character of the fossil shells found in the rocks, both over and under the coal. In what manner these changes were brought about, remains for future geologists to determine, after the science has become mature.

Where not removed by degradation, or buried under other strata, there seems to have been three distinct deposits of coal throughout the main coal region, embraced on the map, which accompanies these observations. After the vegetable materials which form the coal beds, were deposited or buried under the superincumbent strata, it would seem that a strong degree of heat had been applied, in addition to the pressure, before they could assume their present bituminized appearance. As we approach the coal beds, in the transition and primitive rocks, the evidences of heat are still more apparent; removing from the anthracite beds all, or nearly all their bituminous contents; and in the primitive, changing anthracite into graphite, or plumbago, which is almost pure carbon. It would appear, that we cannot reasonably doubt the action of heat on these coals, for the plumbago is evidently a coal, changed by heat into its present semi-metallic appearance, and is often produced in the furnaces of the arts, by the action of heat upon carbon. A less degree of heat has been applied to the bituminous beds of "the Valley of the Ohio," for they are far removed from any crystalline or transition rocks, on which the marks of heat are so apparent, and therefore could not receive a sufficiency to deprive them of their bituminous principles and change them to carbonaceous coal beds. The suggestion advanced by many geologists, and recently applied by Prof. Hitchcok, in his geology of Massachusetts, that graphite, anthracite and bituminous coals are all of vegetable origin, and changed by heat and pressure to what they now are, is a simple and beautiful illustration of a heretofore obscure and difficult subject.



COL. LONG'S PLAN OF BRIDGE BUILDING.

The annexed plan of, and certificates in relation to, Col. Long's Bridge, has been several months in our possession, and ought long since to have been laid before our readers. We publish a part of the certificates accompanying the drawing, which give an idea of the estimation in which the plan is held by practical men.

The undersigned, agent for Col. Long of the U. S. Engineers, offers to all persons interested in Bridges, as is believed, the most important and latest improvement which has yet been made in bridge-building.

The plan of building is such as to bring into profitable use timber of any length, and to build at any length of span from 20 feet to 300 feet between bearings.

Among the important advantages possessed by Col. Long's bridges over others, the following are believed to be peculiar to his:

All the strain on the important timbers is length wise; and this too without any material strain or thrust against the the abutments.

Any defects which time shall make, can be repaired with the same facility as the putting in of the original timber.

The work is so well secured as to admit of driving at any speed, with perfect safety, and without injury to the structure.

A great number of bridges built on this plan are already in use in the Eastern, Middle, and Western States; all of which have fully answered the most sanguine expectations of the Architects and Proprietors.

Moses Long.

The following selections are from the numerous recommendations of Col. Long's plan of bridge-building:

"*Baltimore and Susquehannah Railroad Office, January*, 1833.—Messrs. Hassard and Curley have constructed for this Company three bridges upon the plan of Col. Long, two of them about 70 feet in length, and the largest 100 feet. I am well acquainted with the different plans that have been adopted for the construction of wooden bridges, particularly Towne's and Burr's, which have been generally used in this part of the country, and I am satisfied Col. Long's plan is superior to any of them, in point of strength, solidity, permanency, and above all, in the facility with which it can be repaired, by replacing any piece of timber without disturbing the structure, so that by constant slight repairs the bridge

will be perpetually renewed, at a very slight expense.

"These bridges have been passed more than five months, with a steam engine and tender weighing at least ten tons, with heavy trains of carriages attached, without causing the slightest perceptible motion of any kind in the bridges, which remain in the exact position they occupied when first erected.

"My opinion in respect to these bridges is sustained by the whole Board of Directors, amongst whom there are several gentlemen who possess much theoretical and practical knowledge on this subject."

(Signed)

GEO. WINCHESTER,
President.

"The bridges above mentioned were built in conformity to my directions, as also several others on other works under my charge, and I fully concur in the opinions expressed by the President of the Baltimore and Susquehannah Railroad Company, in favor of Col. Long's plan of bridge-building."

(Signed)

WM. G. MCNEILL,
Captain Top. Engineers.

I hereby certify that under the direction of Col. J. M. Fessenden, the Engineer of the Boston and Worcester Railroad, a bridge has been constructed on that Railroad over the Charles River, on the principle of Col. Long's patent. The bridge rests entirely on two abutments thirty feet in height, and has a span of a hundred and twenty feet between the abutments. Notwithstanding the distance between the abutments which are the only points of support, it has been found to be remarkably stiff, and free from yielding or oscillation on the passing of the heaviest loads, which often consist of eight or ten loaded cars, in addition to the locomotive engine and tender. It was built by Mr. Thomas Hassard of Baltimore, and has been standing a little more than a year. It is considered by the Directors of the Railroad quite satisfactory both in principle and in workmanship, and remarkably well adapted from its firmness and apparent strength, for a Railway bridge.

(Signed)

NATHAN HALE, President
of the Boston and Worcester Railroad.

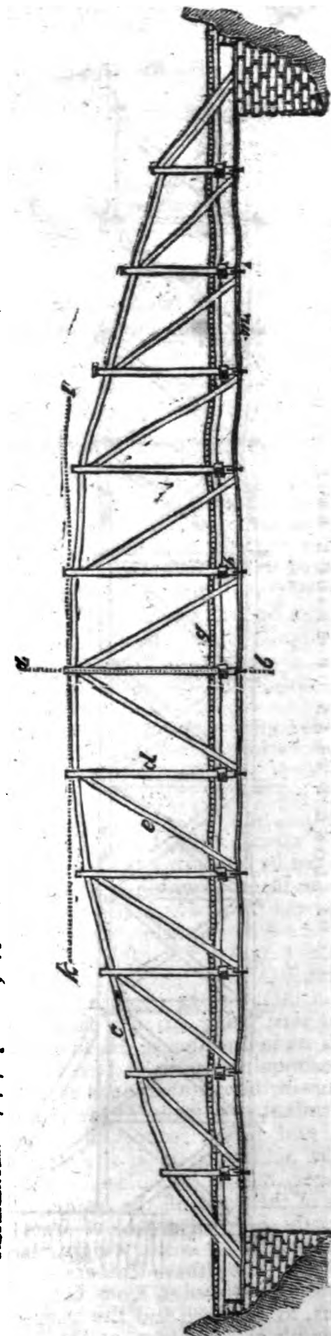
Boston, Dec. 11, 1834.

MOSES LONG, Esq., of Warner, N. H., is the agent of the patentee.

LIEUT. GEORGE W. LONG'S PLAN OF BRIDGE BUILDING.

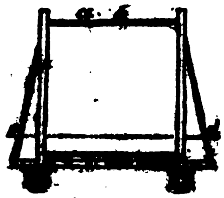
Fig. 1—A Longitudinal Section.

REFERENCES.—a, b, c, top braces; d, posts; e, braces; g, floorway; i, iron rings.



Eliptical Frame Bridge, invented by Lieut. Geo. W. Long, and patented March 10, 1830.

Fig. 2—*A Transverse Section.*



We cheerfully give place to the following communication, in relation to Lieut. Long's plan of bridge building. It will be found we think worthy of attention and should have been published by us at an earlier day, but with many other communications, was delayed by the illness of the editor.

In considering the above plan for a bridge, it may be compared to a beam supported at each end, to do which, it is necessary to consider that in a beam of great length compared with the depth, it becomes a load for itself; and that a greater length of beam can be had by reducing it to the shape to be equally strong throughout, which is all that is requisite for a bridge. In a solid beam, this reduction may be had to the shape of an elipsis, and in the frame it does not differ very essentially from the same. The above frame, then, is calculated on the principle of the beam, with the strings as the first point of fracture, and the top braces as the last, and reduced to that shape to be equally strong throughout. Or it may be explained by comparing the top braces to an arch, the thrust of which is received by the strings, and resisted by them, producing between the different sets, counter stress of the same magnitude to each other, and here this plan has advantages over other framed ones, for intead of the opposing stress of the top timbers, being carried parallel to the strings as in direction of H. L. (see the figure) andrequiring a set of ties to brink it back again, these timbers are directed down, and terminates in them. This simplifies the frame, and greatly reduces the expense of it. The actual stress on the strings and top braces, may be calculated by the proportion of the depth of the frame, and half the length of it, as depth of frame, is to half the length, so is the weight placed on it, to the stress on these timbers in weight. This proportion comes from both demonstrations, by the arch and the beam, taking the strength of the beam as the depth instead of square of the depth, as in a solid beam. This stress on the timbers, it will be seen, is in their strongest directions, and thus with a proportional depth and increased size of the setimbers, the strength of the bridge may be carried to an unlimited extent, without undue expense. The drawing shows the mechanism of the frame so plainly, that it is deemed unnecessary to give very particular explanations of it.

In 1831, the proprietor of the patent gave the use of it for a bridge over Tanners Creek, near Lawrenceburg, Indiana,* for the first one constructed, the result of which was given him by the person to whom the use of the patent was given, Jonathan Woodbury, in the following words, viz.

"The patent which your liberality furnished me with, has been made use of, and instead of a bridge that would cost $12 or $15,000, the Committee which I informed you of for building a bridge, have just completed said bridge, which cost $3,130;" "its whole length upwards of 400 feet, and its width 22 feet, fifty feet high from the bed of the creek, and seventy-six (76) feet span between the piers, the whole of wood except two stone piers 19 feet high, from the bed of the creek, and framed timbers upon these piers for the arch to rest upon, the other part of the bridge is on bents 20 feet apart, all finished in a workmanlike manner." "That part which we are indebted to you for, is thought to be the best model ever yet found out, both as to strength and cheapness."

"The strength of your patent is thought to be almost beyond calculation, by a comparative view of its cheapness, and the size of its timbers; and should it prove as good as we now anticipate, I have no doubt but it will be a source of income to you; we shall have a fair experiment of all its qualities."

The size of the timbers given for the above bridge, was 8 inches square. The bridge is yet standing (1835) and has, so far answered the public expectations, and others are now building in the same neighborhood.

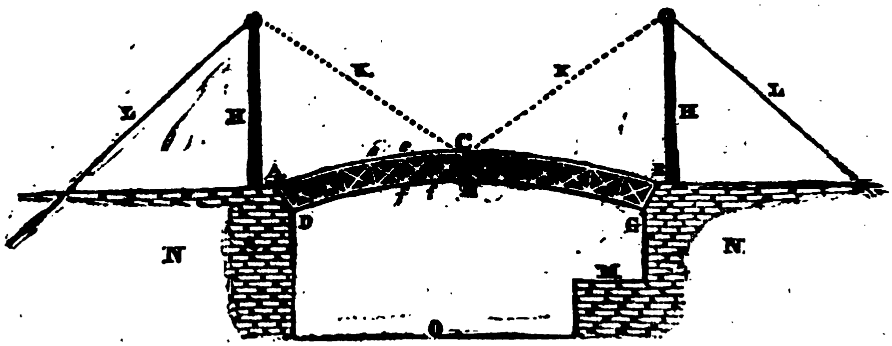
[George W. Long.

Chambly, Oct. 24th. 1835.

D. K. Minor, Esq.

Dear Sir,—I am anxious to try steamboats on the Canal that is at the point of completion here. I have a schooner which is well calculated to receive an engine of ten or twelve horse power, and would put one in her if I could get it cheap. Will you please to advertise in such a way, for a small engine, that I need not be obliged to take it, if beyond my means of payment. I should like a second hand one, and if high pressure, I should not object. Will you let me know the answer to your advertisement, and if an engine is offered cheap, I will come on and see it.

HOPKINS' CAST AND WROUGHT IRON DRAW BRIDGE.



I have just been making a cast and wrought iron draw bridge, of 35 feet span, of which I send you a sketch; it cost $1500, stone work and all.

From A to B is 36 feet, the versed sine of the arch is 2 feet, and the depth of the rib from C to E is 2 feet. The bridge is composed of 3 ribs, like the one A C B E, braced together, and planked over the top. The upper bar A C B, and the posts *e f*, *e f*, are composed of iron cylinders (cast), through which wrought iron rods are passed; the cylinders are 2½ inches in diameter, and the rods passing through them are 1¼ inches; the rods passing through the post cylinders have eye bolt heads, and the rod that threads the upper cylinders passes also through these eyes; the post rods pass through the lower bar D E G, which is of wrought iron, ½ inch by 3 inches; the braces should be hollow cylinders, whose exterior diameter is 1¾ in., and which are ¼ in. thick; but it was found difficult to cast them here, and they were cast feathered. At G and D are cushions of wood to receive the bridge, in descending the posts. H H are hollow cylinders, furnished at top with a cross rod and drums for the lifting chains K K, and a counterpoise of 6 cwt.

The weight of iron is,

Cast Iron,	14,312 lbs.
Wrought Iron,	9,389

You will see that the object in making the upper part of the bridge cast iron was to resist the crust, and that the lower part was wrought to resist extension.

Will you send me your Canal Map?

Your obedient humble servant,

Wm. R. Hopkins.

[From the American Railroad Journal]

Sir—My attention was forcibly drawn to the remarks of your correspondent, in the January number of the Journal, on the subject of Suspension Bridges, and more especially with his liberal and magnificient design of erecting such a structure at the Fulton Ferry. *The views of that gentleman are worthy of the enlightened state of* the arts, and in keeping with the advancements of the age; and although the measure he proposes has elicited no public attention, that I at this distance am aware of, it has doubtless made a permanent impression upon the minds of those within whose peculiar province it falls.

It is not my intention to say any thing in addition to the subject of his communication; but as it is connected, in my mind, with the design of this paper, a recurrence to it serves as a suitable introduction to a notice of a Bridge upon a new plan, which the inventor is about to patent, and which, to my view, seems to possess a peculiar adaptation to the site of the Fulton Ferry, whilst its general application would not be less profitable in minor constructions.

A Bridge of the form that I am about to speak of, may be termed (without impropriety, I suppose,) a Suspension Bridge; but the important point on which I differ from those at present known, consists in the employment of continuous bars of wrought iron, instead of chains made up of links; thus (ceteris paribus, diminishing the *weight* of the metal one half, and probably in the proportion of two to five, and also] enabling the architect to extend his bars much more tensely than can be done with chains in the present mode of erection. Indeed, in a span of one hundred or one hundred and fifty feet, the tension can be given so as to present but a slight departure from a straight line, and the curvature will be nothing more than that which results from the elasticity of the metallic bars themselves.

It is proposed to secure these bars, at their extremities, and to pass them over abutments (and peers where they may be required by the breadth of the stream,) in a manner no wise different from the usual chain-fastenings; but as they will assume

but a very slight curve from *sagging*, compared with the catenarian curve, which gives a corresponding obstruction to the waterway, unless the suspension towers have considerable elevation, these abutments will be required to be raised but to a moderate height above the surface of the stream, thus reducing to a great extent the cost of a bridge in all situations, and demonstrating the practicability of its erection on sites where otherwise the expense would not admit of them for many years to come, and in some, most probably, never.

Moreover, a Bridge of this construction may be provided with a draw, upon a plan, which I believe, is equally novel and ingenious. This is to elevate the two piers, inclosing the draw, to a height sufficient to pass the tallest vessel that may apply, and over these to extend a second series of the continuous bars, terminating in braces, which may be securely fastened in various ways at the ends. The moveable floor is suspended from these by pendulous rods, whose upper extremities are attached to the axles of two or more flanged or grooved wheels, plying upon the upper series of bars in such manner that when the draw is closed, the wheels repose in the midway of the opening, and as it is opened, recede *pari passu*, with the floor towards the pier. If a Bridge on this plan were built at a point of great thoroughfare, an accessary pathway for foot passengers might be made by a stairway over the summits of the piers, while the opening of the draw would only obstruct the passage of vehicles.

In addition to economy of construction, the inventor thinks it is an important feature, that if any parts need renewal, they may be removed without impairing the strength, and replaced by others, and thus the whole structure be consecutively renewed, like the gradual absorption and deposition of the particles of the living frame.

It was not my purpose to say more (nor indeed so much) of the form of this Bridge at present. That objections may be suggested against it, I have no doubt, but I think they are all susceptible of removal or obviation, and none can apply that do not attach with much greater force to Chain Bridges, whose utility and adaptability to the most critical and difficult situations are not now matters of question. My object was to call to it the attention of those of your readers who are more qualified by their habits and experience to judge of its claims, and perhaps to draw forth their opinions. S. M.

Baltimore, March 12th, 1835.

*. Accompanying this communication we received drawings of two forms of this Bridge, both intended for draws, and one in illustration of the stairway, for foot passengers. They were not intended for publication, yet they are at the service of any gentleman who may desire to examine them. The plan certainly has novelty, if no other merit for its recommendation—and we ask for it an attentive perusal.

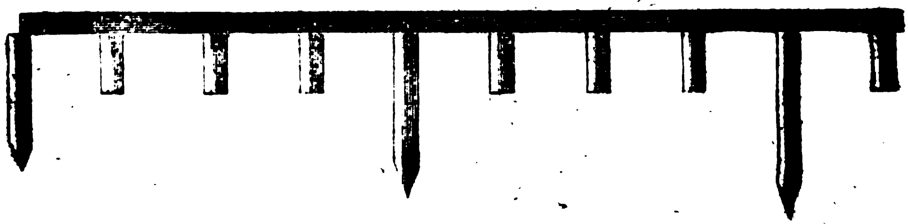
The following plan for constructing Railroads, is submitted for the consideration of our readers. It will be found useful, in many parts of the country, for passing soft or marshy ground, and perhaps for the construction of cheap roads. We are truly obliged to Mr. Haskins, as we are to every gentleman, who favors us with his views on the subject of Railroads.

Mr. Minor,—I subjoin, for your publication, a plan for constructing Railroads, which, so far as I know, has not been advanced by others, and which may be found useful. I made a suggestion, some four years since, embracing the principle, in an article upon the Mad River Railroad, which appeared in one of our public journals. In April last, I drew out a plan and specifications, and submitted them to the Directors of the Aurora and Buffalo Railroad Company; since which, some copies thereof have been obtained for Engineers upon other works for examination.

Durability, and the *maintenance of fixed levels*, are matters of the first importance, in Railroads. I believe Engineers do not estimate the durability of these works, when constructed upon any one of the most approvad plans at present in use, at over ten or twelve years; that is, without expenditures which almost equal the cost of rebuilding upon the same grade. If this is so, I believe the subjoined plan for constructing will prove valuable; for, while its cost will be found (where suitable timber is plenty) intermediate between the *most* and the *least* expensive Roads that have been made, it will produce a Road which, without any material repairs, will maintain its level, and remain good from sixty to eighty, and in some cases even one hundred years. I know full well that *driving piles* is nothing new in Railroad construction. Over marshy grounds these Roads have always been carried on piles, but on dry ground, the expense would be too great to drive as many piles as would be needed for *all* the rests. The proposed plan is designed to secure a fixed level for very long periods of time, without undue expense. The grading will be the same in this as in other cases.

The engraving below, exhibits a vertical

HASKINS' PLAN FOR CONSTRUCTING RAILROADS.



section of Road, the stretchers which are to receive the rails, resting at either end, upon piles driven into the earth, and intermediately upon blocks of wood. The stretchers and piles are each one foot through, and the blocks the same. The piles varied in length, as the soil varies in which they are to be driven, the depth being always such as to secure their firm position, against the action of frost, or of rains, in softening the soil. Piles thus driven, at distances to accommodate the length of the stretchers, when cut off to the grade, become *fixed points of level.* The blocks—used intermediately, to save expense—to have sawed, parallel ends, and to be adjustedto the same level as the piles, the earth being driven in tight around them. Their length I have assumed at three feet. When at hand, a flat stone might be laid beneath each block, with advantage. These blocks, by the use of the Road, will, in time, settle more or less; but, as each end of the stretchers remains *fixed* upon the piles, these central depressions may, at any time, be elevated to a horizontal line, by wedges driven under the stretchers, upon the heads of the blocks—a process alike cheap and effectual.

The length of the stretchers, and the distance between the supports, or blocks, will be matters of consideration. The former I have assumed at twenty feet, and the latter four feet. Probably, as the stretchers will rest upon the soil, the distances between the supports may, in many Roads, be considerably greater than this. The stretchers should be tied, at suitable distances; though few ties will be necessary, if the stretchers be firmly bolted to the heads of the piles. These ties, when a horse-path is intended, should be cut away in the centre, so that the gravel of the path will form a smoother surface above them.

The piles, blocks, stretchers, and ties, which constitute *the whole work*, except the iron rail—if of beach, cedar, or locust, and cut in winter, will exceed in durability the extreme of human life.

R. W. Haskins.

Buffalo Sept. 4, 1835.

To the Editor of the Railroad Journal:

Mr. Minor, Sir,—In your Railroad Journal there has been much said on the subject of the tenacity or cohesion of iron, but in regard to the particular shape or form for Rails, (for wear and economy,) I am not aware that the subject has been much dwelt upon. From my *observations of the* different Railroads that I have seen, I am convinced that there is an immense difference in the economy and wear of the different kinds of Rails, and have no doubt that it is owing to the different shapes that the iron is wrought into, more than to the quality of iron used in their manufacture.

I have observed a great difference in regard to the splitting and scaling of Rails, by compression, (*from use*)—it appears to me that the flat or plain Rails can, and would be wrought more compact, and in wear there would be at least 50 per cent. in their favor.

From conversations with many of the Directors of Railroads, I have not found that the subject has been much thought of. The safety in travelling on Railroads depends much on the solidity or compactness of the iron. The Rails that split or scale the most, must of course be more dangerous; the next consideration is economy in their results, for long use, and not for the mere consideration of their first cost *only*.

Will some of your numerous correspondents take the subject into consideration?

Yours obediently,

P. Fanning.

We cannot reply to the above questions for want of experience, and therefore call upon those of our practical and experienced friends to answer them for us, through the Journal.

It is important that this subject should receive attention, and we are ready to do our part, publish it, when we receive the answer.

[From the American Railroad Journal.]

QUERIES TO ENGINEERS.—We have been requested to submit the following queries to the consideration of Engineers, and to request replies to them through the Journal.

1st, What rate of ascent per mile is preferable for the use of locomotive steam power, to that of stationary, upon a straight line of Railroad, the distance the same in both cases, the cost for construction the same in both cases, the freight, passengers, and as many as can be transported upon a good permanent double tract, upon a level Road?

2d, What rate of ascent per mile is preferable for the use of locomotive steam power, upon a curved line, say 1000 feet radius, to that of stationary power, by making the curves between the planes of a smaller radius, say 500 feet, and the planes for stationary power on straight line, distance, cost, and transportation, as before mentioned?

3d, What rate of ascent per mile is preferable for the use of locomotive steam power, to that of stationary, as in the 1st and 2d question, provided the transportation is only half the Road is capable of doing?

4th, What rate of ascent per mile is preferable for the use of locomotive steam power, to that of stationary, as in the 1st, 2d, and 3d questions, with the exception of passengers, as freight and transporting produce and merchandize?

5th, What extra distance is equal, by going around an elevation and depression, to that of going over at the rate of 60 feet per mile, for a distance of 2 miles, 1 mile each way from the summit, the level the same on both sides of the ridge, the curves the same in both cases, the cost for construction the same in aggregate, transportation to be passengers, as in the 1st question?

6th, We will fix the rate of ascent for locomotive power, at 60 feet per mile for this question, and say, we have 10 miles to ascend at the same rate, for the transportation of passengers, as in the 1st and 2d question, cost for grading is \$10,000 per mile=\$100,000, and further say that a location can be made near the one proposed, by rising 40 feet per mile, for the 1st 5 miles, and the remaining 5 miles will ascend at the rate of 80 feet per mile, this location will cost less money than the 1st, how much less should it cost to make it equal to the 1st, distance the same in both cases?

I have asked the above, questioned in that simple, plain, and pointed way, in order to prevent the gentlemen avoiding the answers of same kind.

RAILROAD BARS.—We find in the London Mechanics' Magazine, the following remarks in relation to a mode of avoiding the jar which occurs in passing over the pedestals, or supports, of the rail.

RAILROAD BARS.—SIR: I have not hitherto directed particular attention to railroads, but as I read Mr. Daglish's letter of the 26th May, an idea occurred to me, which I am induced to offer, through your columns, to the consideration of those connected with great undertakings of that kind. I will put my idea as a question:—Is it not possible to produce a railroad with uniform elasticity, or, at least, so nearly so as to avoid the inconvenient and injurious jar experienced while the wheels of a carriage are passing over the pedestals and joints?

To effect this, I propose that the ends where the different portions of the rails meet should have corresponding notches to admit keys, for the purpose of keeping all fair at top. These keys might be extended to the rails on both sides of the road, to keep them parallel and at a uniform distance. The vertical joints where the ends of rails meet to be open, to allow for expansion; and for the same reason also, the vertical joints at the sides of the keys. Horizontally the keys to be as tight as possible in the rails. The rails are to be kept in their vertical position by the mortices in the chairs, and to be fastened down to them by the keys. Each portion of the rails is not to rest on the bottom of the mortices in the chairs, but upon a transverse bar or bars, whose strength and bearing are to be precisely that which will produce the same degree of elasticity as that of the rails, that is, if the wheels of a waggon were passing immediately over these bars, or the keys in the joints of the rails, there would be no more tendency to jar than if they were rolling on the rails in the middle between any of the supports.

This idea may be applied to a great many, or all the variety of forms for the rails; but I think with Mr. Daglish, that the rails, from their upper to their under surface, ought to be as little as possible. And, indeed, to produce steadiness in motion, the centre of gravity of a train of carriages, and the goods they contain, cannot be kept too low.

I am, sir, your obedient servant,

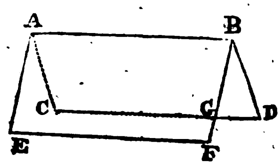
JOSEPH JOPLING.

31, Somerset-street, July 11, 1835.

On the Resistance of Fluids; by GEO. W. KEELY, *Professor of Natural Philosophy, in Waterville College.*

SIR,—I perceive in No. 55 of the Journal, that Professor Wallace has announced a new measure of the resistance of a fluid in a direction perpendicular to a plain surface moving in it, viz: That it is as the sine

of the inclination of the plane. Permit me to state my reasons for adhering to the old doctrine, that the perpendicular resistance is as the square of the sine of inclination. It is well known that the latter measure has been deduced from the alleged facts that the *number* and the *force* of the resisting particles vary as the sine of the inclination. If it be true that the resistance to a plane surface moving in a fluid is as the number of particles it strikes in its course, and that the number of particles in any indefinitely thin fluid lamina is as the area of that lamina, (neither of which we think Professor W. will deny,) it follows that, if BD be a section of a plane inclined to the direction BA of its motion, and BF an equal section of an equal plane perpendicular to the same direction, the number of particles BD will strike is to the number that BF will strike in the same time, as the parallelogram ABCD is to the parallelogram AEFB; and the resistances are therefore, on this account, as BG is to BD, or as the sines of the inclinations of the sections; the resistances to the planes are of course in the same ratio.



Now this familiar demonstration would seem to settle the question; but Professor Wallace argues, "that the number of particles striking the plane does *not* depend on the breadth of the fluid column BG BF, but *on the surface of the plane*, because the particles that act on the plane are those in contact with it, and therefore their number is as its superficial area." Now, admitting it to be true that the number of material particles in contact with the plane, at any instant, is the same, whether it be perpendicular or inclined to the direction of the motion, it does not, we think, necessarily follow that the number of particles struck in any given time will be the same. But neither is it evident that the number of particles in contact with the plane is the same for every inclination of the plane. The burden of proof, however, seems to lie with Prof. W. He has *assumed* the general physical fact that the number of particles in contact with the plane, at any instant, is the same for any position of the plane, and he has deduced an inference, not formally expressed, indeed, but surely implied, otherwise the argument is worth nothing, that the number of particles struck in any given time is as the number in contact with the plane at any instant. Now we think the fact and conclusion may very safely be denied, and it becomes Prof. W. to shew that they are consistent with some hypothesis respecting the form and relative position of the ultimate particles of a fluid body. In any hypothesis, we believe the following positions will be found to hold:

First. Whether the number of particles, at any instant, in contact with the plane, in different positions, is the same, *depends* wholly on the hypothesis.

Second. If the number is the same in different positions, it will be found that the number of fluid strata struck in any given time, is as the sine of the inclination.

Third. If the number is *not* the same, then it varies as the sine of the inclination, and the number of strata struck will, in any given time, be the same.

If Prof. W. can *devise any hypothesis* with which these positions do not agree, we will allow he can disturb our belief in the truth of the law of the square of the sines.

The wide difference between the results of observation and those of the old theory, would tend rather to dissuade us from admitting the truth of the new, when we consider what important physical circumstances are and must be omitted in the conditions.—[Silliman's Journal.]

[From the Repertory of Patent Inventions.]

Specification of the Patent granted to HENRY BOOTH, *of Liverpool, for Compositions or Combinations of Materials applicable for the Greasing of the Axle-Bearings of Carriages, and the Axle-Spindles and Bearing-parts of Machinery in general, denominated Patent Axle-Grease and Lubricating-Fluid.*

Mr. Booth says, my patent axle-grease and lubricating-fluid are chemical compounds of oil, tallow, or other grease, and water, effected by means of the admixture of soda or other alkaline substance, in such proportions that the compounds shall not be of a caustic or corrosive nature when applied to iron or steel, but of an unctuous greasy quality, easily fusible with heat, and suitable for greasing the axle-bearings of carriage-wheels, or the axles, spindles, and bearings of machinery in general. And the proportions of the ingredients for the said compounds, and the method of compounding them, which I recommend as suitable for the above purposes, are as follow:—

For the axle-grease suitable for carriage-axles, and particularly for the axles of every description of railway carria-

ges, a solution of soda in water, (the common washing soda of the shops,) in the proportion of half a pound weight of soda to a gallon of pure water; to one gallon of this solution add three pounds of good clean tallow and six pounds of palm-oil; or, instead of the mixture of tallow and palm-oil, add ten pounds of palm-oil, or eight pounds of tallow, (the tallow being of a stiffer nature than palm-oil.) The said tallow and palm-oil, or either of them, and the solution, as described, must be heated together, in some convenient vessel, to about 200° or 210° of Fahrenheit, and then the whole mass must be well mixed and stirred up together, and be agitated without ceasing till the composition be cooled down to 60° or 70° of Fahrenheit, and have obtained its consistency, which will be that of grease or butter, in which state it will be ready for use, and may be applied in the way in which grease is usually applied to machinery.

For the lubricating fluid, which, also, is applicable to the rubbing parts of machinery, (and particularly to the spindles of pulleys on inclined planes moving on wooden bearings,) I recommend to be taken of the aforesaid solution of soda in water, one gallon; of rape-oil, one gallon; and of tallow or palm-oil, one quarter of a pound weight: heat them together to 200° or 210° of Fahrenheit, and then let the fluid composition be well stirred about and agitated without intermission till cooled down to 60° or 70°, when it will be of the consistency of cream; or if a thicker consistency be desired, a small addition to the tallow or palm-oil may be admitted; and in all cases it is advantageous to shake or stir up the mixture immediately before using it.

Now, though I have given the foregoing proportions of ingredients, as suitable, under ordinary circumstances, I do not mean to limit the invention to these precise mixtures; as according to the temperature of the weather, or the particular purpose to which it may be applied, a little more tallow or other grease or oil, and less of the solution may be desirable; or slight alterations in the quantity of soda for the solution, or in the relative proportions of tallow and palm-oil or other grease, may be found advantageous—a larger proportion of soda in the solution, and a larger quantity of tallow in proportion to the solution, rendering the compound stiffer, and less easily fusible in hot weather; all which modifications of my patent compounds will be easily adjusted by the superintendents of the machinery to which they may be applied. In witness whereof, &c.

Enrolled June 4, 1835.

[From the same.]

Specificatian of the Patent granted to Joseph Ferguson, *of the City of Carlisle, in the County of Cumberland, Manufacturer, for a certain Combination of Processes whereby a new kind of Dress or Finish is given to certain Goods.* Sealed December 23, 1834.

To all to whom these presents shall come, &c. &c. *Now know ye*, That in compliance with the said proviso, I, the said Joseph Ferguson, do hereby declare the nature of my said invention to consist in giving a new kind of dress to twilled, plain, or figured cotton goods, which have been beetled by submitting them to certain known processes, not heretofore applied, after beetling, to produce that effect. And in further compliance with the said proviso, I, the said Joseph Ferguson, do hereby describe the said processes and the order in which the same are to be applied, by the following statement thereof, (that is to say):

I take plain, twilled, or figured cotton cloths beetled in the usual way by a beetling-machine for fifty or sixty hours, in order to bring them to a very high gloss, and put them over a damping-machine so as to be completely saturated with water. I then put them through a drying-machine with copper cylinders and heated with steam in the usual way, taking care to put them through, when twilled, as tight as the cloth will bear without tearing, so as to open out the twill as much as possible during the drying process; when the cloths are plain, or figured, only, and not twilled, then the usual degree of tension applied to goods in drying-machines will be sufficient, and in all cases it is preferable that the heat and speed of the drying-machine be such as to dry the cloth completely by the time it gets once through, provided the color, (if dyed goods,) be such as to admit of it, if not, it should be dried at two or more operations.

The stiffening of the goods should in all cases also be particularly attended to, inasmuch as the more firmly they are stiffened, whether before or after beetling, the more defined and perfect will be the dress.

Now whereas I claim as my invention the combination of the damping or saturating and subsequent drying processes with the process heretofore in use to produce beetled goods, as hereinbefore described, and applied to the purpose of giving a new kind of dress or finish to such goods as aforesaid. And such my invention being, to the best of my knowledge and belief, entirely new and never before used within that part of His said Majesty's United Kingdom of Great Britain and Ireland called England, His said dominion of Wales, or town of Berwick-upon-Tweed, I do hereby declare this to be my specification of the same, and that I do verily believe that this my said specification doth comply, in all respects, fully and without reserve or disguise, with the proviso in the said hereinbefore in part recited letters patent contained; whereof I do hereby claim to maintain exclusive right and privilege to my said invention. In witness whereof, &c. Enrolled June 23, 1835.

[From the same.]

Tables of Discounts, Net Proceeds, and Per-Centage Profits upon the Sale of Goods: on a New Plan of Arrangement: being more comprehensive and more expeditious for consultation, than any hitherto published. By DAVID BOOTH, Author of the Interest Tables, &c. &c. London: Simpkin, Marshall, & Co.

The recording of improvements from time to time made in our *manufactures*, may perhaps be supposed to include the noticing of any thing that may tend to the advantage of the *manufacturer;* and to this supposition we attribute our being favored with the work before us, which holds out the advantage of enabliug the manufacturer to calculate his discounts, and reckon up his profits more expeditiously than heretofore.

We will describe, rather than attempt to review, this publication, as to do that properly would require that we should calculate the Tables to prove their accuracy,—a task we cannot undertake;—but supposing them to be correct, we conceive that this work must be invaluable to manufacturers, whose goods are sold subject to various discounts. The Tables are assorted in pairs, fronting each other. The one page gives the amount of discount on any given sum, at the rate marked at the top (that is, at 1¼, 2½, 3¾, and so on, up to 48¾ per cent.,) and the opposite page gives the net proceeds of such sum, or amount remaining after the discount is deducted. To the general tradesman this work must be equally useful, enabling him to calulate his profits with great facility. We therefore conceive that we are rendering to our manufacturing and trading readers a useful service by recommending them to possess themselves of these Tables.

THE BRISTOL AND GLOUCESTERSHIRE RAILWAY (from Bristol to the great Westerleigh coal-field) was opened on the 6th inst. It is 9 miles long; and the cuttings and embankments are supposed to be greater than on any railway of similar extent which has yet been formed. There is a tunnel (under Staple Hill) 1,540 feet long, 12 wide, and 16½ feet high; it is in a straight line, 3 shafts by which the excavations were carried on being left open to admit light. One of the embankments is 56 feet in height. The capital expended on the undertaking is about 77,000*l.* The Act was obtained in June, 1828, and the works were commenced in June, 1829. Mr. Townsend is the engineer.

LIVERPOOL AND MANCHESTER RAILWAY—*Seventh Half-Yearly Meeting.*—The Directors reported a continued increase in the traffic, as compared with the corresponding six months of last year. The receipts of the half year ending 30th of June, amounted to 99,474*l.* 16*s.* 6*d.*, and the expenses to 61,814*l.* 6*s.* 1*d.*, leaving a net profit for six months of 37,660*l.* 9*s.* 10*d.* A dividend of 4*l.* 10*s.* per share (for the half year) was resolved upon. The shares are now quoted at 200*l.*

STEAM CARRIAGES ON COMMON ROADS.—Mr. WALTER HANCOCK performed a journey of 75 miles, from London to Marlborough, in his steam carriage, the *Erin,*—originally called and described in this journal as the "*Era.*" The time occupied was about twelve hours, seven and a half of which was running time, as will be seen by the following account:—

JOURNEY FROM LONDON TO MARLBOROUGH IN MR. WALTER HANCOCK'S STEAM CAR-

RIAGE, THE "ERIN."—Sir: The "Erin" steam carriage, which was built by Mr. W. Hancock to run on the Paddington road, and originally called the "Era," (described in your journal, No. 585) started from Stratford on Tuesday morning last, at half-past four, for Marlborough, with a party of gentlemen. Mr. Hancock had attached a small tender to the carriage, containing coke and water sufficint to have lasted us to Reading; but the bar of wood, through which the bolts ran that fixed the tender to the carriage, gave way in Cheapside, and we were obliged to leave the tender behind us.

The carriage reached Hyde Park corner by six o'clock, where we remained about half an hour to take in some of our party, and proceeded on to Reading, which we reached at 11 minutes past 11 o'clock. The company stopped there an hour and a half and dined; after which the journey was resumed.

The carriage reached Marlborough by half-past 6 o'clock, with no other accident than the breaking of one of the bands of the blower. The total time on the road was a minute or two short of 12 hours, of which 4½ were occupied in stoppages, leaving 7½ hours for travelling the 75, being at the rate of just 10 miles an hour.

No one who has not travelled by steam carriages can imagine the inconvenience and delay which results from the want of regular and ample supplies of water; the carriage having to stop from 14 to 18 minutes every 10 or 12 miles to fill the tanks by hand-buckets from pumps, with sometimes the additional inconvenience of having to take the supply from some neighboring stream or pond. While the carriage is stationary, the fire slackens in consequence of the blower being stopped, and it requires about two miles running to get it again into full play. By observations which I made on the road while timing the carriage, I found that the rate of the first three miles, after taking in water, averaged 7½ minutes a mile, whilst the latter part of the distance, till the carriage again stopped for water, averaged one mile in five minutes. Frequently the men were obliged to use any kind of water they could get; some being filled with duck-weed, straw, and filth of every description, which, of course, very much retarded the generation of steam. The inconveniences arose in the present case chiefly from the loss of our tender, which would have carried us to Reading without any stoppage.

All these delays would, of course, not happen, if water stations, having tanks with large hose, which might fill the carriage in a minute, were provided. There is no doubt, that had such arrangements been made for supplying the "Erin" on the present journey, it would have performed it, including stoppages, in 6 hours; though the carriage was not built, I am informed, nor intended for long journeys, but for such short distances as between London and Paddington.

Mr. Hancock started from Marlborough to return to London on Friday at half-past five. The carriage accomplished the ascent of Marlborough hill—the steepest acclivity on the Bristol road, being full one mile long, and having a rise of about 1 in 7, in 6 minutes, with a stoppage of 4 minutes. The "Erin" reached Reading by 10, and stayed 1½ hour for breakfast. After running through the town we continued our journey, and reached London by half-past five, being again 12 hours on the road, and having lost nearly about the same time in stoppages as on our journey down.

Our reception on the road was very cordial; there was scarcely any manifestation of bad feeling throughout the journey; indeed, wherever we stopped to take in water, we had every assistance given us by the bystanders. We were particularly well received at Marlborough, where we stayed two days. The carriage made a trip through the town each day; and Mr. Hancock astonished the inhabitants by the easy manner in which he could turn, stop, or back his carriage. Two gentlemen of Marlborough most hospitably entertained the steam travellers whilst they remained in that town.

Subjoined, I give a table of the performances of the steam carriage taken from the notes of the gentlemen who timed the carriage.

And remain, yours truly, R.

London, August 10, 1835.

Messrs. MAUDSLEY AND FIELD performed the same distance in five hours 49½ minutes, running time.

JOURNEY FROM LONDON TO MARLBOROUGH BY MESSRS. MAUDSLEY AND FIELD'S STEAM CARRIAGE.—The journey from London to Marlborough has been also recently performed by the steam carriage constructed by Messrs. Maudsley and Field for Sir Charles Dance, Mr. Macneil, and other gentlemen. We extract the following statement of its performances from a letter of Mr. Macneil to the newspapers. It will be seen that the rate of speed realized was nearly the same as in the case of Mr. Hancock's "Erin;" but the time occupied in stoppages was less, owing, no doubt, to

better arrangements having been made for the supply of water:—

"Time on the road in going down	8	10	30
Deduct stoppages - - - - - - -	2	21	4
Total time while moving - - - -	5	49	26

Which gives about 12·86 miles per hour whilst running.

Time returning - - - - - - -	11	22	0
Deduct stoppages - - - - - - -	4	2	0
Total time moving - - - - -	7	20	0

Which is rather more than 10 miles per hour whilst running."

[From the American Railroad Journal.]

On the Location of Railroad Curvatures; being an Investigation of all the Principal Formulas which are required for Field Operations, in laying Curves and Tangent Lines, to pass through Given Points. By J. S. Van De Graaff.

(Concluded from vol. vi., p. 160.)

27. The preceding articles, with their obvious combinations, embrace all the cases which can occur in the field, by a method of computation rigorously accurate, and of convenient application. But before closing this part of the subject, the following example will be here given, as a general illustration of the method to be pursued when an alteration is proposed in a line after the completion of a location.

Let D A F A′ G L represent a located line having the following character: D A, a tangent; A F, a curve, modulus of curvature 2° 3′, and length 18 chains; F A′, a tangent, length 0 chains; A′ G L, a curve, modulus of curvature of the part A′ G, 2° 52′, and length of the same part, 15 chains. Now, it is proposed to remove the origin A 4 chains *back* upon the tangent line D A, to a station B; and to lay a curve B R 15 chains, with the same modulus of curvature, 2° 3′; and it is required to know what would be the direct distance R Q between the two curves from the point R. And if a tangent R X′ be laid from the point R, it is also required to know the proper position in that tangent line, for the origin B′, and the necessary modulus of curvature, in order to trace a new curve B′ G in such a manner as to pass again into the original line G L with a common tangent at the station G.

Because B R = 15 chains, and B A = 4 chains, the difference is 11 chains, and the curve A Q will therefore obviously contain more than 11 chains when R Q is normal to the tangent R X′. Hence, taking the station Q at the extremity of 13 chains, the data for computing the line R Q by means of (XXV.), will be, T′ = 2° 3′, $n = 13$, $m = 15$, and $\propto = +4$; or, $2n\mathrm{T} = 53° 18'$, and $2m\mathrm{T} = 61° 30'$; and therefore is $= \left\{ \frac{\cdot 01022}{\cdot 00256} - 4 \times \frac{\cdot 87882 - \cdot 80178}{\cdot 03577} + 16 \right\}^{\frac{1}{2}} = (4{\cdot}00 - 4 \times 2{\cdot}153 + 16)^{\frac{1}{2}} = \sqrt{11{\cdot}388} = 3{\cdot}38$ chains nearly = R Q. And by (XXVI.), $\text{Cos. P} = \frac{1{\cdot}076 - 4}{3{\cdot}38} = -\cdot 8651$; that is, $\mathrm{P} = 210° 6'$. Hence, the angle Q R X′ will evidently be expressed by $2m\mathrm{T} + 210° 6' - 180° = 91° 36'$; which being nearly a right angle, proves that 13 integer chains in the curve A Q, corresponds most nearly with a true normal line Q R. The length of the line Q R furnishes the data by which to judge of the *situation of the ground at the* point R.

The origin, and curvature of the new curve B′ G, will now be investigated by means of (XVII.) and (XVIII.) Let any arbitrary point K be selected for the origin of a system rectangular axes K X′, K Y′; and compute the values of the co-ordinates A′ H′, H′ K, of the origin K, taken with reference to the rectangular axes which have their origin at A′.

In such a case as the present, it would be most convenient to take the point K coinciding with the station R; but in order to retain the results given in a former example, take R K = 12 chains; and the values of the required co-ordinates will then be, A′ H′ = + 1·37 chains, and H′ K = + 1·58 chains.

The co-ordinates of the point G, taken with reference to the axes K X′, K Y′, may now be computed by means of (XXI.), after the co-ordinates of the same point, taken with reference to the axes at A′, have been determined by (VII.) To find these latter co-ordinates, the given data are, T = 2° 52′, and $n = 15$; or, $2n\mathrm{T} = 86°$. Hence, by (VII.), $x = \frac{\cdot 99756}{\cdot 10002} = 9{\cdot}98$ chains, $y = \frac{\cdot 93024}{\cdot 10002} = 9{\cdot}30$ chains. Now, the data necessary for computing the new co-ordinates by means of (XXI.), are, $\propto = +1{\cdot}37$, $\beta = +1{\cdot}58$, $z = +12° 18'$, $x = 9{\cdot}98$, and $y = 9{\cdot}3$. Hence, $x' = 10{\cdot}88 \times \cdot 2130 + 11{\cdot}35 \times \cdot 9770 = 2{\cdot}32 + 11{\cdot}09 = 13{\cdot}41$ chains, $y = 10{\cdot}88 \times \cdot 977 - 11{\cdot}35 \times \cdot 213 = 10{\cdot}63 - 2{\cdot}42 = 8{\cdot}21$ chains. The inclination of a tangent at G, to the tangent F A′, is expressed by 30 × 2° 52′ = 86°; and therefore the inclination of a tangent at G, to the tangent R X′, is expressed by 86° − 12° 18′ = 73° 42′. The given data by which to compute the position of the new origin B′ by means of (XVIII.), will therefore be X = 13·41, Y = 8·21, and D = 73° 42′; that is, $\propto = 8{\cdot}21 \times 1{\cdot}334 - 13{\cdot}41 = 10{\cdot}95 - 13{\cdot}41 = -2{\cdot}46$. The required origin B′, of the new curve B′ G, will therefore be situated 2·46 chains in *advance* of the selected point K;

that is, the length of the new tangent R B' is 14·46 chains. By (XVII.), Sin. T $= \frac{\cdot 71933}{16\cdot 42} = \cdot 04381$; or, T = 2° 30¼' = modulus of curvature of the required new curve B' G.

SCHOLIUM.

When the curves under consideration are *long*, and also embrace portions of circumferences greatly exceeding 20° or 30°, the trigonometrical formulas investigated in the foregoing articles become of the utmost importance in the field. But there are several well known approximative formulas which will sometimes be found useful auxiliaries in the first location of a line where short and frequent curves are introduced; and they will also very often be convenient when certain alterations are proposed in a known line, and a new line is required to be selected by computation. It is therefore the design of the remaining part of the present inquiry to show how those approximative results may be easily deduced from the rigorous formulas already given.

28. By means of (VI.), we have $y = \frac{\text{Sin.}^2 n\text{T}}{\text{Sin. T}}$; and therefore the quantity $n^2 \times$ Sin. T will always *exceed* the value of y. Hence, $n^2 \times$ Sin. T will express the value of some ordinate *oblique* to the axis of x.

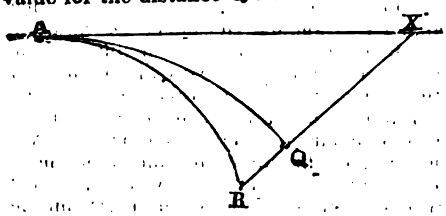
Let this *oblique ordinate* be denoted by K; and the following expression will obtain:

$$\text{K} = n^2 \cdot \text{Sin. T}. \quad \text{(XXXVI.)}$$

But by putting $q = 0{\cdot}01745$, which is the length of an arc of one *degree*, to a radius unity, and supposing the angle T to be measured *in degrees, and decimal parts of a degree*, the result will be, that $q \times \text{T} =$ Sin. T very nearly. The value of the oblique ordinate K will therefore be nearly expressed as follows:

$$\text{K} = qn^2\,\text{T}. \quad \text{(XXXVII.)}$$

29. Suppose T and T' to denote the respective moduli of curvatures *in degrees* of two curves A Q and A R, which are laid from the same point A, and upon the same tangent line A X; and let each curve contain an equal number of chains represented by n. It is proposed to find an approximate value for the distance Q R.



Let Q X and R X be the two oblique ordinates whose values are expressed by qn^2T, and qn^2T', respectively. If, then, those two ordinates be supposed to coincide with each other, which will not be far from the truth, then their difference in length must express the required distance Q R. Hence, taking w to represent the line Q R, the following formula is evidently the result:

$$w = qn^2 \cdot (\text{T} - \text{T}'). \quad \text{(XXXVIII.)}$$

The formula thus obtained is an exceedingly near approximation of the true length of the line Q R, when the curves A Q and A R do not contain more than 20° or 30° each; but its application in the field is confined to that particular case only in which those two curves contain each the same number of chains. And although the length of the line w, as thus computed, will not differ so much from the true quantity as to produce a material inconvenience in the location of a line in a slightly undulating country, even when the two curves embrace portions of circumferences greatly exceeding 20° or 30°, yet, in such cases, if the result were even rigorously true, a knowledge of the *length* of the line w will be of little use in the field when the *obliquity* of that line remains unknown. The formulas (XXIII.) and (XXIV.) must, therefore, in such a case, be resorted to, in order to discover the true position of one of the curves when the other is given; but when those two curves each embrace only a small part of the whole circumference, it will be sufficient in practice to measure the line w as a normal to either curve, in which case, the expression (XXXVIII.) will be highly useful.

It is sometimes required to find the modulus of curvature of one of the curves, when the other curve and the line w are given data; in which case the following formula obtains:

$$\text{T}' = \text{T} \pm \frac{w}{qn^2}. \quad \text{(XXXIX.)}$$

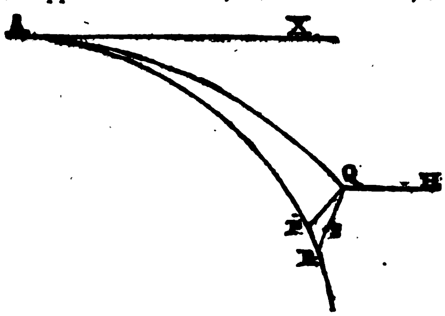
This expression is immediately derived from a transposition of the one preceding.

Three examples will be now given, the first of which will be a case where the formula (XXXVIII.) is not at all applicable; the second will explain a case where that formula can not be used alone with advantage; and the third will show an instance in which the same formula will be very useful in the field.

Example 1. Let a curve whose modulus of curvature is 2° 45', be traced 20 chains of 100 feet each, from a given point and from a given tangent line. Now it is proposed to lay another curve from the same origin, and from the same tangent line, and whose modulus of curvature is 3°. How far would this latter curve pass from the extremity of the former?

Here, by (XXXVIII.), $w = \cdot01745 \times 400 \times \frac{1}{4}^\circ = 1\cdot75$ chains $= 175$ feet $=$ the required distance as determined by the approximative method. But this result is too far from the truth to be of any practical utility, as will appear from the following accurate calculation. Taking the extremity of the 19th chain for the termination of the new curve, the given data in (XXIII.) are, $n = 20$, $m = 19$, $T = 2^\circ\ 45'$, $T' = 3^\circ$, and $\alpha = 0$; that is, $x = \frac{\text{Sin. } 110^\circ}{2 \text{ Sin. } 2^\circ\ 45'} = \frac{\cdot93969}{\cdot0960} = 9\cdot79$; $y = \frac{1 - \text{Cos.} 110^\circ}{2 \text{ Sin. } 2^\circ 45'} = \frac{1 + \cdot34202}{\cdot0960} = \frac{1\cdot34202}{\cdot0960} = 13\cdot98$; $x' = \frac{\text{Sin. } 114^\circ}{2 \text{ Sin. } 3^\circ} = \frac{\cdot91355}{\cdot1047} = 8\cdot73$; $y' = \frac{1 - \text{Cos. } 114^\circ}{2 \text{ Sin. } 3^\circ} = \frac{1 + \cdot40674}{\cdot1047} = \frac{1\cdot40674}{\cdot1047} = 13\cdot44$; or, $x - x' = 1\cdot06$, and, $y - y' = 0\cdot54$. Hence, $w = (\overline{1\cdot06}|^2 + \overline{\cdot54}|^2)^{\frac{1}{2}} = (1\cdot1236 + \cdot2916)^{\frac{1}{2}} = \sqrt{1\cdot415} = 1\cdot19$ chains $= 119$ feet $=$ true distance from the extremity of the given curve, to the station at the termination of the 19th chain in the proposed curve.

Example 2. Let A R represent the curve of a graded roadway, and suppose A Q to be an approximate curve, traced 10 chains, of



100 feet each, with a modulus of curvature of $2^\circ\ 45'$. From the extremity at Q, suppose a normal line Q P to be measured 40 feet to the centre of the roadway at P. It is proposed to show a method of ascertaining the modulus of curvature which will trace the curve A R.

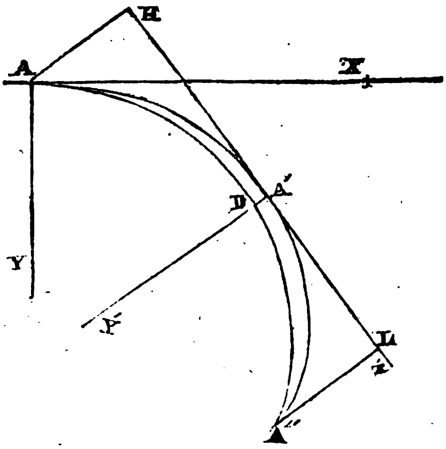
In order to obtain an approximate value for the new modulus of curvature by means of (XXXIX.), the given data are, $T = 2^\circ\ 45'$, $n = 10$, and $w = \cdot4$; that is, $T' = 2^\circ\ 45' + \frac{\cdot4}{\cdot0175 \times 100} = 2^\circ\ 45' + \frac{\cdot4}{1\cdot75} = 2^\circ\ 45' + \cdot229^\circ = 2^\circ\ 45' + 13\frac{3}{4}' = 2^\circ\ 58\frac{3}{4}'$. Now, if a new curve were to be commenced at the origin A, and traced agreeably to the modulus of curvature $2^\circ\ 58\frac{3}{4}'$, it would not touch the point P by a deviation of about 3 feet, as an accurate calculation will show, and a variation of even 6 inches from the true centre of a graded surface is frequently a matter of some consequence. If a small error be made in the modulus of curvature at the commencement of a curve, it is not a proper remedy, after the line begins to deviate a material quantity from the true centre, to make a new change of curvature merely to correct the former error; for such a method of operation not only shows a great want of skill, but it also multiplies the difficulties when the road at any future time may want adjustment. When, therefore, the approximate result, $2^\circ\ 58\frac{3}{4}'$, has been obtained, the next thing required to be done, by means of an instrument placed at Q, is to ascertain the true *position of a point* S, where *the extremity of the 10th chain in* the new curve would be situated, without actually tracing that curve upon the ground. The length and position of the line Q S may be correctly computed by means of (XXIII.), and (XXIV.); and then having measured the amount of error S R, to the centre of the roadway, the modulus of curvature required may be determined by means of (XXXIX.) For the given data will then be $T = 2^\circ\ 58\frac{3}{4}'$, $n = 10$, and $w =$ measured distance S R.

It will be here easily observed that there are two sources of error in the first result obtained from (XXXIX.) The greatest part of this error arises from the want of coincidence in the directions of the lines Q P and Q S; for an accurate calculation will show that in the present example, a difference of $13\frac{3}{4}'$ in the moduli of curvatures corresponds accurately with a distance of 39 feet between the two extremities of the curves, which agrees with the distance supposed in the first calculation, within one foot. But owing to the obliquity of the line Q S, a new curve laid from the origin A, agreeably to the modulus of curvature $2^\circ\ 58\frac{3}{4}'$, would intersect the line Q P at about 37 feet from the point Q, and therefore pass 3 feet from the true centre of the roadway.

Example 3. Suppose A A' and A' A'' to represent two different curves, connected together upon a common tangent at the point A', and selected in the field by tracing systems of rectangular lines agreeably to the method of co-ordinate axes as explained in art. 17; and let the *numerical values* of all the quantities remain as in the example given for that article. Now, in the place of these two curves, it is proposed to lay one continuous curvature from A to A'', if the ground about the intermediate point A' will permit such an alteration; and it is therefore required to know how far the new proposed curve A D A'' would pass from the point A'.

It is very evident that the co-ordinates

A″ H, H A, of the point A, taken with reference to the axes A′ X′, A′ Y′, are respectively equal to the co-ordinates x, y, of the point A′, taken with reference to the axes A X, A Y. Hence, the given data for com-



puting the modulus of curvature of the proposed curve A D A″, by means of (XXII.), are the following: α = A′ H = 20·21 chains, β = — H A = — 12·47 chains, x 17·18 chains, y = 10·24 chains, and z = — 63° 20′. Therefore, Sin. T′ =

$$\frac{-2{\cdot}23 \times \text{Cos.}\,63^\circ\,20' + 37{\cdot}39 \times \text{Sin.}\,63^\circ\,20'}{-\overline{2{\cdot}23}|^2 + \overline{37{\cdot}39}|^2}$$

$= \dfrac{32{\cdot}412}{1403} = {\cdot}02310$; or, T′ = 1° 20′ = modulus of curvature which would trace the continuous curve A D A″.

The data for computing the distance A′ D by means of (XXXVIII.), will now be, n = 25, T = 1° 16′, and T′ = 1° 20′; that is, $w = {\cdot}0175 \times 625 \times \dfrac{4}{60} = 0{\cdot}75$ = the required distance A′ D nearly, expressed in chains.

30. When two curves, having their respective moduli of curvatures represented in degrees by T and T′, are laid from different origins upon the same tangent line, let α denote the number of chains between the origins. If, then, the curve T be continued n chains, and the curve T′ be supposed to contain $n \pm \alpha$ chains, it is evident that the following formula will obtain for a reason similar to that in the preceding article, the quantity w denoting the same line as before:

$$w = qn^2\,T - q \cdot \overline{n \pm \alpha}|^2 \cdot T'. \qquad \text{(XL.)}$$

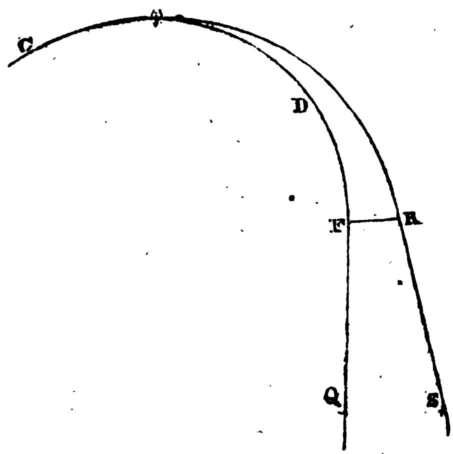
The expression thus obtained will be frequently useful in the field when *short curves* only are under consideration; and if it be supposed that $w = 0$, a formula may obviously be easily deduced which will correspond to (XIX.) by an approximation. For then $n^2 T = \overline{n \pm \alpha}|^2 \cdot T'$; that is,

$$T' = T \times \frac{n}{n \pm \alpha}\Big|^2. \qquad \text{(XLI.)}$$

This expression is remarkably simple, and will be very convenient for short curves.

31. Let C A D F represent a given curve, whose modulus of curvature is denoted in degrees by T, and let it pass into a tangent F Q at any given station F. Let also F R represent any small distance immediately on the right or left of the station F, and R S a straight line, whose inclination to the line F Q is denoted by a given quantity z°. It is then proposed to determine a point A in the given curve C A D F, and the requisite change of curvature at A, in order to lay the curve A D F into the position A R, and the tangent F Q into the position R S.

Take w to represent the small given distance F R, and let n denote the required number of chains from A to F, and T′ the required modulus of curvature of the new curve A R.



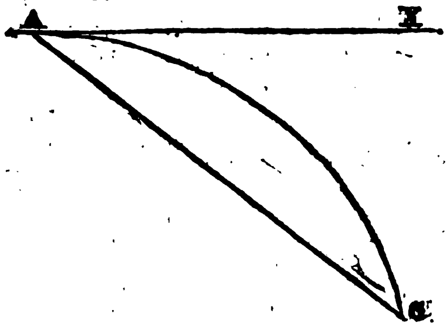
The two equations, $z = 2n \cdot (T - T')$, and $w = qn^2 \cdot (T - T')$, are furnished by means of (V.) and (XXXVIII.) respectively; and therefore, by eliminating n and T—T′, the following expressions will result:

$$n = \frac{2w}{qz}$$

$$T - T' = \frac{qz^2}{4w} \qquad \text{(XLII.)}$$

These formulas will be very convenient in the field when two short curves in reversion are to be connected by means of an intervening tangent common to both curves.

32. Suppose A X to represent a given



tangent line, and A a given point therein, which is designed for the origin of a certain required curve to be laid passing through a given point G. Suppose, also, that the point G is visible from the origin A, and that the approximate distance A G is known. It is then proposed to find the necessary modulus of curvature, in order to trace the required curve A G.

By means of an instrument placed at the origin A, let the angle X A G be measured, and let its value be denoted by D′. It evidently appears from (II.) that the angle D′ will contain the modulus of curvature as often as the curve A G contains chains. Hence,

$$T = \frac{D'}{n} \qquad \text{(XLIII.)}$$

The expression thus obtained is extremely simple, and for short curves will be highly useful in the field.

Extract of a Letter from our Correspondent, A. W., dated,

Lansingburgh, 27th August.

Business calling me to New-York, about the middle of June last, and not having completed it on the first of July, and finding, from appearances, that little could be done, till after the celebration of the Fourth of July, I took the opportunity to make an excursion of two or three days to Philadelphia.

Stepping on board the morning six o'clock boat, I was enabled, by a rapid, but pleasing and changeful travel, by land and water, to reach Philadelphia in time for dinner at the United States Hotel. Some people live to eat, and others eat to live; and as I belong to the latter class, I did not pounce my eye on the preparations for dinner in the spirit of a *gourmand*. I merely noticed the profusion of viands on the table, but I could not help, being a stranger, observing the superiority in good, wholesome, well-baked bread, fresh vegetables, and choice butter.

When dinner was over, I took a walk to the Navy Yard. The first impulse was, of course, to find something new, and worthy of inspection. With very little search, I found an object which answered the purpose. This was the new national ship, Pennsylvania, of 140 guns, now on the stocks. It was my good fortune to meet with a gentleman who was probably an officer of some grade, at any rate, I think he was worthy to be one, at least as far as politeness is concerned. He showed me, with an apparent feeling of national pride, every thing connected with it, and answered all my questions, not only with a thorough knowledge of the subject, but with seemingly as much pleasure as I could possibly take in asking them. I took minutes from some of his answers, and among the principal ones I find the extreme length of the ship is 217 feet, its greatest breadth 59 feet, and its depth, amidships, 51 feet. But as naval architecture is not my object, though I took several other notes, I will not tax the printer nor the reader with them. As I had another use for the remaining part of the afternoon, I took a rather painful leave of my interesting guide, reflecting, at the same time, with what wonderful accuracy the sweet and bitter of life are balanced; for the extreme pleasure I took with this momentary acquaintance, was exactly balanced by the pain of parting.

I now steered my course to Washington Square, a fine specimen of taste and liberality. It is situated in the southeasterly part of the city, and I was told that it contains about eight acres. It is beautifully laid out, and planted with ornamental trees, selected from various parts of the world, but, as they should be, mostly natives of our own continent; for certainly, while the Eastern Continent can boast of its ancient ruins, its broken columns, and relics of the arts of other days, now trodden under foot, and crumbling into dust, the proper field, in which to search for the beauties of nature, and to explore her inmost recesses, will be

found in the forests of America. The sun was now descending far in the west, and its light striking in bold relief on the trees and flowers, and reflected from different shades of green, presented a scene beautiful beyond description.

The city contains several other spacious and beautiful squares, but I had not time to visit them. Why is it that our other cities and villages are destitute of these delightful appendages? No reason can be given, but that they were laid out, as we know was the case in the early settlement in our own State, without any plan at all, or the ground has been seized on, and sold in speculation, to gratify the sordid views of forestallers.

> When thirst of gold enslaves the mind,
> And selfish views alone bear sway,

every nobler feeling—every spark of laudable national pride vanishes, as colors vanish when light is withdrawn.

The dusk of evening was closing around me, and I returned to my lodgings. The day's exercise had given me an appetite for a wholesome supper, and a night of quiet repose, both of which were duly enjoyed.

At daylight next morning, I took a stroll through the market, and was soon convinced that its celebrity was justly merited. The building and accommodations were in themselves highly worthy of notice. Stretched nearly a mile in length, through the middle of a wide avenve, which is a great thoroughfare through the centre of the city, from one river to the other; and forming, on each side of it, a street of convenient width. Its plan, for beauty and convenience, could scarcely be improved. But to give an idea of the contents of this market, all I can say, from so short an inspection is, it contains samples of every thing which ever was, or can be exhibited for sale in a public market. The meats in general were fine, but the mutton, in particular, surpassed any display of that article I have ever seen. The butter was exhibited in a style of neatness and taste, which would draw tears of pleasure in the eyes of an Epicure. But it was not these more prominent articles only which attracted attention; every thing the eye could recognize, animal, vegetable, mineral, or fossil—natural or artificial, was there, and all so tastefully arranged, that the smallest article seemed to say, examine me too; while the choice fruits, flowers, and fresh vegetables, whispered, with more conscious dignity, here you may see the effect of liberal premiums from the Pennsylvania Horticultural Society.

After breakfast, taking all the rest of the day before me, I set out to view the gardens, water-works, &c.; and, taking a hackney coach, my first course was steered to Bartram's Garden and Nursery. These are situated on the west bank of the Schuylkill, about three miles from the city, and are now owned, and judiciously managed, by Mr. Robert Carr, the son-in-law of Mr. Bartram, who is well known as a botanist and naturalist; and his very superior collection of North American trees and plants, show him in the very pleasing light of being truly national.

On a stone over one entrance to the house, I noticed the date of 1731, rather roughly but plainly cut. On inquiring, I found that this front of the mansion was built at that period; and another inscription, purporting to have been cut 39 years afterwards, reads and spells thus:

> "It is god alone almyty lord
> The holy one by me adored.
> "JOHN BARTRAM, 1770."

The garden, it is said, was commenced about four years before the date of the first inscription, and is now about 114 years old. I was informed that Mr. Bartram and his son must have been about 100 years in collecting this valuable legacy they have left to the Flora of North America. A small strip of land, containing less than seven acres, was said to contain rising 2,000 species, natives of our own country. But I found also a no less rich treat in examining the exotics, which were very numerous and valuable. The collection of Camillas and tropical plants, surpassed any thing of the kind I had ever seen; among the latter were some fine specimens of Zamias, Ficus, Euphorbia Hetirophylla, &c. The grounds were tastefully laid out, and besides the amazing variety of smaller trees and shrubs, arrang-

ed, apparently, to the best possible advantage, the effect is still heightened by the grandeur of several trees, majestically towering above, and overspreading the rest: among which are a Norway Spruce, at least 80 feet high; a Cypress, (*Cupressus disticha,*) 25 feet 6 inches in circumference, and 114 feet high; native Magnolias, Flowering Acacias, &c. And beneath this lofty display of variegated foliage, on proper fixtures, I noticed a magnificent Sago Palm, the circumference of its foliage 24 feet, and the stem 3½ feet. But it is vain to attempt enumeration, when the bare catalogue would four times exceed my limits.

Between this beautiful and magnificent grove and the Schuylkill, are several fishponds, with gold and silver fish and acquatic plants; and still farther on, towards the river, is an ancient cider-mill, cut, with great labor, out of the solid rock, near which was a small plot of Gama grass. From the numerous accounts of the productiveness of this grass at the south, particularly in North and South Carolina, it must be found a good substitute for clover, herds grass, &c. &c., and its introduction of great importance to that section of our republic. But from an examination with some of it, raised in my garden, and also the opinion of Mr. Carr, who has had it on his grounds a dozen years, I am led to conclude it will be of no great value to our northern farmers. The vines and fruit nurseries were extensive, and appeared in perfect keeping with the rest of this splendid establishment.

Nor was this display of nature more pleasing than the polite attention of its worthy proprietor, who not only answered, with apparent pleasure, all my questions, which, to say the least, extended to the utmost bounds of civility, but showed me many deeply interesting curiosities, and, among other things, his extensive and valuable library, principally on Agriculture, Horticulture, and Botany, which seemed to say,

"Come, let me make a sunny realm around thee,
Of thought and beauty! Here are books and flowers."

Leaving this place with reluctance, I steered my course to Lemon Hill, which is the name very appropriately given to the pleasure grounds of Mr. Henry Pratt. It is situated in the immediate vicinity of the grand Water-works, and is said to contain over twenty acres. Nature seems to have displayed her utmost power in modelling this charming situation, leaving but little for art to accomplish, to render it one of the most delightful spots on earth; and art, with such a bold and lovely model, appears to have availed herself of every advantage, to beautify and complete what Nature had so happily begun.

The mansion is placed on an eminence, commanding a delightful view of the Schuylkill, just at that point where every thing is in *pleasant motion. The busy neighbor*hood of Fairmount, the interesting views of this fine landscape, are fully kept before the eye, by gently winding paths, through a rich and well kept grass plot; every turn producing some new and pleasing effect. The foot does not tread in the same path which the eye has gone over before. The groups of lofty trees, so advantageously placed on the hill, near the house, with their deep green foliage, form a beautiful contrast with those of more light and stinted growth, situated in front of the ground bordering on the water; thereby adding much to the effect, by seeming to remove the perspective to the farthest *extremity* of the picture. The numerous well stocked fishponds, with their islands and aquatic productions, summer-houses, gardens, porters' and laborers' lodges, all well placed for picturesque effect; and the beautiful little grotto, thrown so chastely over the mineral spring, all conspire to complete the beauty and variety, without, in the least, marring the productions of nature, so very interesting in the immediate vicinity. The spacious green hot houses, with their numerous and lovely tenants, spread far and wide in every direction, making the whole garden a repository of flowers and fragrance, certainly stand prominent in their kind; and as we migrate along the well kept gravel walks, so richly adorned by tree, shrub, and plant, of every shade and shape, and from every climate, intermixed with the inmates of the green house, the shaddock, orange, citron,

lime, the fig tree, laden with inviting fruit; the sugar cane, pepper tree, banana, guava, and plantain; the cheremalia, mango, and splendid cactus; a reflecting mind must be lost in admiration, not knowing which most to admire, the amazing variety produced by nature, or the wealth, liberality, and taste, which have planted and sustain them there.

As I cast a valedictory glance at this enchanting scenery, the power of association brought forcibly to my mind the sligthed and neglected talents of my worthy friend Perrine, whose whole soul is compounded of botanical science and horticultural taste. Had the magnanimity of our wise National Legislature been sufficient to have granted his petition, for a few acres of wild, and, probably for a long time to come, worthless land, on the peninsula of Florida, and the little pecuniary aid, to which every sensible man in the nation would have been proud of contributing, to enable him to establish a national repository, for the introduction and acclimation of exotic plants, he would ere now have exhibited all the beauties and rich treasures of the vegetable world, flourishing in high exuberance, without the expensive aid of artificial heat. One half of the amount, which the patriotic and noble spirited proprietor of this establishment has expended, from his own purse, would have accomplished his object in a manner highly creditable to the nation, and profitable to the present and future generations. But public bodies, like corporate bodies, have no souls.

But I found the plan of my pleasing excursion, as I now find that of my letter, extended beyond the bounds to which circumstances limit its accomplishment; and I had then, as I have now, to quit the subject almost at the beginning. You know my attachment to the subject of horticulture, and you know there is nothing else so pleasing to me, except the cultivation of the human mind. But here I had both the subjects before me; one, in the situation I have so faintly described, and the other, in the more than pleasing urbanity and politeness of its proprietor, either of which, to say the least, I never saw excelled. I have ever been of the opinion, that a spirit to relish, and taste to direct horticultural improvements, is commensurately an evidence of an amiable and philanthropic disposition; and, if proof were wanting, I found it amply displayed, in the kind attention, which, as a stranger, I received, not only from Mr. Pratt, but from his principal gardener.

The day was now far spent, and I had only time to take a slight glance at the water-works. As I am not familiar with the subject of mechanics, and if I were, I had now no time for

> "Examining with care each wondrous matter
> That brought up water."

I can only say, of the whole, it is a stupendous establishment. But there was a peculiar charm to me in the reservoir on the hill, consisting of three beautiful sheets of water, and a fourth in operation.

The time I had allotted for my stay was nearly exhausted, and I had examined but two of the gardens, of which I had procured a long list. I had promised myself the pleasure of visiting Mr. Parker's Botanic Garden, Mr. McArran's Botanic Garden and Nursery, Mr. Hibbert's Nursery, Messrs. Landreths' Nursery, and others of equal celebrity; but the imperious call of business compelled me to forego the pleasure, and it being now Saturday night, I returned to my lodgings.

On Sunday morning I attended Church. But in the afternoon, as an exercise not altogether unapropriate for the day, I visited Rolinsan Rural Cemetery. This is a place which, though no person of common sense could leisurely enter with feelings of levity, yet no reflecting mind could spend a few moment's contemplation in it, without experiencing emotions of exquisitely pleasing satisfaction, though still partaking of a sober seriousness nearly bordering on melancholy.

This place contains 2½ acres. It was commenced in 1827, and now contains between 4 and 5000 interments, and about 100 vaults. When it was first commenced a lot about 10 by 8 feet sold for $40, but will now command from $90 to $100. An adult stranger can be buried for $6, and a

child for $4, including opening and closing the grave.

The place is inclosed on three sides with a handsome stone wall, and the front side with an iron railing. On the right hand of the entrance is a dwelling for the attendants to the concern, where they are at all times to be found. On the left is a green house, with rooms over it for meetings of the lot-holders and managers.

The plants in the green house are for the purpose of ornamenting graves, at proper seasons; and hardy flowers in great variety are growing, tastefully and liberally seattered over the ground.

Among the various and numerous monuments, some were of peculiar elegance. I noticed one, on which the incription stated that it was executed in Italy. It was of exquisite material and workmanship, and I could not help admiring the skill in the fine arts peculiar to that country; but looking a little farther, I was most agreeably astonished to find one executed in Philadelphia, quite surpassing it; I could not but indulge some feelings of pride in reflecting on the amazing improvement since 30 years ago, when similar monuments were ornamented with an awful staring death's head and marrow bones.

Among the interments I noticed that of a Chinese, aged 37, buried in 1830. Part of the inscription was in the Chinese character.

I could not view this interesting spot without painful reflections, on what appears to me the unpardonable want of similar institutions in the great and opulent State in which I live. Can it be from a want of social affection in the people in this state, or can it be from feelings of parsomony, that we grudge the expense, that we suffer our friends to be put under the turf to-day, and the place of their rest broken up and perhaps appropriated to some other use to-morrow? The Corporation of your city are selected for their supposed fitness, and are duly authorised and empowered to manage and direct all affairs of public interest; and is it not a duty they owe to protect the public feelings, from what must be daily suffered by persons who cherish with tender affection the memory of their deceased friend, when they see the place of their remains turned into a common highway, or perhaps dug up, and their bones scattered and trodden into dust?

This is naturally a public concern; but if it does not soon receive the attention the importance of the case demands, it will pass into the hands of private speculation, from which it would be difficult to return it to its proper channel, and which would place it in a state truly to be deplored by every person whose heart is warmed by a spark of philathropy or patriotism. But to return.

On Monday morning I left Philadelphia, and I can truly say, *I never spent three* days in more pleasing gratification. Getting on board the steamboat, I lost much of the beauty of the scenery on the way to Trenton, by accidentally taking up part of a number which I had not seen before, of a new and beautiful little periodical entitled the Zodiac: it so completely engrossed my attention, that I saw nothing else till I had finished perusing it, just as we arrived at Trenton.

As natural history is in some measure my hobby, of course my attention was particularly occupied by the *Naturalist's* book, in which I was confident I recognized the pen of my esteemed friend Doct. ——, and I determined to patronize the Zodiac at my return.

A. W.

[For the Mechanics' Magazine.]

TO OUR AGRICULTURALISTS.

Foreigners, the least conversant with the grades of society in Europe, are much surprised at the low social estimation of the agriculturalists of this country. In every part of the civilized world, excepting this, they are ranked among the foremost in public opinion; here, every petty shopkeeper is considered their superior. There are many exceptions to this rule, but as a class it will be admitted to be correct.

There must be something radically wrong in the self-estimation of our farmers, or such an inverted state of their esteemed condition could not exist. To endeavor to induce them to make a fair estimate of

themselves, is the object of this essay. I will attempt to show them why, as a class, they ought to rank at least as high as any other, and then point out to them why they now rank so much lower in public opinion than those of the same class in other countries. I have no wish to increase their pride, for man has nothing to be proud of; besides, pride, as the term is generally understood, is a mean, grovelling quality, exactly adverse to a fair appreciation of ourselves in oursocial capacity.

The fact, that the cultivators of the soil are the primary producers of the whole wealth of a country, is of itself sufficient proof of their superiority as a class. This fact will no doubt be denied by many of our dealers and shopmen, who are incapable of tracing effects to causes, and who, wrapt in self-conceit, have assumed a station that does not belong to them. The fact, however, can be easily demonstrated, which I shall endeavor to do in as succinct and plain a manner as possible.

We have about two millions of families, including farm laborers, employed in agricultural and horticultural pursuits. This estimate may be considered excessive, for there may be less than two thirds of our whole population engaged in cultivating the soil; but however much beyond the reality, it alters the conclusion to be drawn from the premises only in diminishing the amount put in circulation annually, not in its inductive facts. We will suppose that the land under cultivation affords no surplus beyond the support, in the first necessaries of life, to those employed in cultivating it. It is evident, in this case, that the farmers having nothing to sell, would be unable to purchase any thing; that every individual of our population would be compelled to cultivate the soil to obtain an existence, for there would be neither sellers nor purchasers. We will further suppose that the average surplus of each family, beyond their own existence, to be fifty dollars per annum, and that the whole of this were wanting to supply agricultural instruments. The amount to be expended would now be one hundred millions of dollars per annum, which would put into operation a given number of workmen in wood and iron, sa well as a small number of dealers to facilitate the receiving and executing of orders. Trade has now commenced, but never could have started but for the farmers' surplus. If the average surplus of each agricultural family should be one thousand dollars, an estimate probably very near the truth, and the greater portion of this surplus be expended in the usual variety of objects which go to promote the comfort and luxury of families, it is evident, that in addition to the workers in wood and iron, there would be put in operation builders, cabinet makers, clothiers, and a thousand other sources of industry.

If, when these agents have accumulated capital, and by this means extended their operations so as to meet the increasing demand of the agriculturalists, shall pride themselves on a factitious superiority, forgetting in toto the source of their wealth, ought they not to be pitied rather than admired by the intelligent part of community?

The amount put in circulation by our farmers, on the last estimate, would be two thousand millions of dollars per annum, and the number of workmen and agents employed to execute orders would be vastly increased. The whole capital accumulated by the country is exactly the amount saved out of this surplus, by the farmers, and the agents and workmen employed by them.

That our farmers should have a surplus of two thousand millions of dollars per annum, over and above feeding their families, would appear, at first sight, to be much overrated; but after deducting four hundred millions for the wages of workmen, and three hundred for buying and planting new farms, building houses and barns, buying new instruments of agriculture and repairing old ones, we shall find that it leaves but about eighty-five dollars per head for our whole population for clothing, furnishing, and other necessaries and comforts sought by those who can afford to purchase them. It should also be recollected that five millions of our population derive all their necessaries, comforts, and luxuries, from this surplus, and that the annual accumulation of capital is a product of that excess.

So long as there is land in a country of first and second rate qualities, for the creation of new farms, so long can this primary source of wealth be extended. There is also ample room in this country for a great extension from the land now under cultivation, as at least one third more product could be raised from it than is now

produced; but as this consummation cannot possibly take place until interest of money and wages are lower, or new labor saving machines shall be invented, we must hope rather than expect to see it realized in our day.

Manufacturers, dealers, and shopmen, and, in fact, all who are not laboring on farms, derive their whole support from this agricultural surplus. The capital, accumulated by those agents who buy and sell, whether merchants, shopkeepers, or dealers in any commodity, being savings from the varied circulation of said product, the farmers ought surely to be entitled to their highest consideration.

This surplus is by no means stationary, and the prosperity of some years, as well as the depression of others, are the results, in the greater number of instances, of the greater or smaller surpluses. If the surplus one year should be twelve hundred millions of dollars, another seventeen hundred millions, and another twenty-two hundred, it would be easy to account for the elevations and depressions in the business community of the country. In fact, the variations which annually take place in these surpluses is the only true barometer of a country's prosperity.

When merchants, manufaturers, and dealers in a country are operating with large masses of capital, the accumulation of many years, concentrated in cities and towns, they lose sight altogether of the original source of wealth. And where the right of primogeniture does not exist, as in this country, to enable agriculturalists to concentrate their property in the heads o families, the other classes will, apparently, be much richer, and claim a superiority. Their riches, however, is only *apparent;* for the far greater portion of wealth in every country must ever remain with the owners of the soil. Much of the capital wielded by dealers is altogether fictitious, being predicated on credit, and a considerable share of their more solid capital is borrowed from the savings of property owners.

Let me ask our farmers why it is, with so many solid claims to superiority, that as a class they tacitly acknowledge themselves inferior to those who are their dependents? I need bring forward but one circumstance to prove the fact. When our farmers have a son they consider more than usually talented, do they not bestow a better education on him, with a view to settle him with some merchant or dealer in our cities or towns, and this with the fearul odds against them of his being ruined in pocket, mind, and body, as is the fatal issue with three fourths of the whole number? This is plainly acknowledging that it requires more talent and a better education to make a dealer and shopman than it does to make a farmer, and this depreciated view of their own condition is the main cause of their being undervalued by the community in general.

There is no business or profession, in the whole circle of human pursuits, that requires more solid talent to execute well than that of cultivating the soil, and there is no class of our citizens whose education is so generally neglected. It is too generally considered that to learn to plough, harrow, sow, drill, and plant; to harvest well when crops are ripe, and sell when ready for market, are all the qualities necessary for a farmer, with the addition of a little cyphering and writing. These, it is true, are necessary qualifications for every man who has the management of a farm; but they are by no means all that are requisite to make the pursuit yield its greatest degree of profit, and sufficiently interesting to attach the most enterprising and talented of its sons to the calling. If the owners of the soil are desirous of acquiring wealth, and at the same time that degree of respectability which will make them respect themselves as a class, they must acquire far more knowledge than the mere drudgery of a farm. They should know practically how to perform every branch of labor, in order to understand when their workmen do them justice; but the *pursuit* must indeed be miserably unproductive and uninviting if the owner of the estate cannot make more by systematizing his business, and superintending the carrying out of the system, than by personal labor. They should understand mensuration sufficiently to be able to calculate the quantity of land after the chain has been run; the advantages of draining, with the most effective and most economical way of operating; the properties of different soils, including a knowledge of what seeds and plants are most productive in each, with a critical judgment of the manures or composts best adapted to different qualities of soil; suffi-

cient of botany to enable them to judge of seeds, plants, and fruit trees, with the best mode of producing them in the greatest abundance and in the highest degree of perfection.

It will not be denied that to acquire such knowledge would be highly advantageous to our agriculturalists, and not only to them as a class, but to the general community, for the average of the farming surplus would become so much larger as to materially benefit the whole mass. But, say they, how is this knowledge to be acquired? neither our common schools, academies, nor colleges, give any such instruction, therefore we have not the means of acquiring it. This objection is too true, and is a truth highly disgraceful to the enlightened age in which we live. The means of acquiring an agricultural education ought immediately to be put within the reach of this our most valuable class of citizens. In every college there are professorships for physic, law, and divinity, but none for that class on which our prosperity and very existence depends. Agricultural schools, academies, and colleges, with experimental farms attached to each, and with such professors as are requisite for the scientific departments, cannot be too soon established. The expense of such establishments would be repaid a hundred fold during the existence of the rising generation. A farmer should learn arithmetic, mensuration, agricultural chemistry, mineralogy, geology, and the physiology of seeds, plants, trees, and animals. A certain portion of his time should be appropriated to acquiring scientific knowledge, the remainder to practical operations of scientific principles. The expense of such an education should be as moderate as possible, particularly in the commencement so low, as to induce those who have but little to spare for education, to send their sons to such establishments, in preference to any others, on the score of expense alone.

With such an education, our farmers, instead of looking to other pursuits for their most talented sons, would feel it a degradation to place them any where but on the soil. Their sons, too, finding agriculture the most exalted of human employments, would be proud of their calling. That time of the year in which they are most unemployed, in place of hanging heavy on their hands, would be appropriated to improving their minds. They would as a class stand boldly prominent in the front ranks of society, and instead of any feeling of inferiority, as is now too much the case, would be able justly to consider themselves on a perfect equality with the best of any class; and that ignorant flippancy they now so much admire in others, would be found hollow and disgustingly nauseous. Politically they would become truly independent, and in place of being the tools of designing political knaves, they would have intelligence to enable them to think justly on every political subject, and manhood to back their opinion. But the most exalted of all considerations would be the effect on their moral condition individually. They would not only be able to appreciate themselves and their pursuit fairly, as a class of the human family, but in the investigation of the wonderful arrangement in the order of nature, they would feel that man was a being of exceedingly limited powers, that his utmost scope was as nothing in the presence of Him whose infinite mind had arranged, and whose infinite power had executed the wonderful works of creation. In possession of a physiological knowledge of the construction of seeds, plants, and trees, with the adaptation of soils to their growth and maturity, their contemplations would open to them a nearer approximation to the Divine Mind, and whether in the field or their chambers, they would enjoy this greatest and most durable of all sources of human happiness, that they were never "less alone than when alone." W. P.

W. P. will not leave the subject, we trust, which he seems so well to understand, with a single communication. Our columns will always be open to such communications.—[Prop. N. Y. F.]

Croton River.—We perceive by a statement in the Daily Advertiser, that the Water Commissioners have requested Mr. Douglass, Chief Engineer of the New-York Water Works, to make a gauge of Croton River in its present state, which has been done accordingly. The result is communicated to the Chairman of the Commissioners, Hon. Stephen Allen, in the following terms:

Sing Sing, 6th October, 1835.

Dear Sir:—It being a rainy day, I have completed my calculations relative to the supply of water in the Croton, and lose no time in sending you the result.

The gauging was performed yesterday (Monday) morning, before the flow had been increased by the working of the Mills above, and probably exhibited the very lowest rate of discharge which has been experienced this season, in consequence of the water having been generally shut back in the ponds during Sunday.

I confess I was somewhat alarmed by the appearance of the stream—it was drawn into so *narrow* a channel, leaving wide margins of its slimy bed, which had rarely, if ever, been uncovered before, and which had evidently been under water the day previous, now *uncovered*—and the stake which I had driven at the former gauging, standing high and dry at a considerable distance from the water's edge. I proceeded with my work, however, and gauged the water, even in this reduced state, with extreme care, and found the result as follows:—

Section of water equal 40 1-2 square feet.

Mean velocity per second 97-100ths of a foot.

Giving for the discharge per second 39 28-100ths cubic feet.

And per day 3,393,792 *cubic feet.*

Which is equal to 21,133,324 standard gallons.

The gauging was performed near Pine's Bridge, and of course did not include Flewwelling's Mill Streams, and several other runs which were found unfailing, and which discharge their waters above the dam. The first mentioned, being the most considerable, were gauged, (two of them,) and found to yield jointly 744,326 gallons, which being added to the preceding result, gives an aggregate of 21,877,650 gallons*—the smaller runs referred to not being included.

I thought it desirable to obtain this result, as being the minimum flow under the most *unfavorable* circumstances; it evidently ought not, however, to be considered as the discharge of any one entire day. The waters had been stopped back on the Saturday night previous, and the stream at the instant of gauging, appeared to be under the full effective influence of this stoppage—probably a few hours would again restore it to its customary height. To verify this fact, one of the party was left behind for the purpose of taking the height of water, by a certain mark, frequently during the next following 24 hours, and the following were the results: at 5 P. M. of the same day, the water had risen 1 7-8 inches, at 9 in the evening *no further change* either way; during the night a storm commenced and continued raining in the morning, so that the rise of water was considerably influenced thereby.—The measurement at 7 A. M. on this morning, for instance, gave a rise of 4 3-8 inches, and at 10 a rise of 7 7-8 inches above the level at the hour of gauging—and there now is, therefore, probably more than a hundred millions of gallons running, from the joint effect of rain and *diurnal* increase.—To avoid any error in estimating the effect of *rain*, I *exclude* the observations of this morning, and deduce my *average daily* supply from the *result of the gauge*, and the *notes of last evening*. These carefully calculated gave 27,954,790 standard gallons; and this, under all circumstances, I consider as the *lowest daily* supply for this year—certainly very much *within bounds*, as I have no doubt from my observation of the stream, that the flow would have been much increased this morning, independently of the rain, and would have given us, could I have ascertained it by an actual measurement, an average considerably higher than that stated.

Having thus deduced what may be considered as the minimum rate of flow at *any one time*, and the minimum *daily supply*, I will just add in connexion, a remark upon the general average of supply, *during the dorught*, for this is the real question of interest in relation to the supply of the city

On the seventeenth of August I gauged as heretofore reported, and found between 43 and 44 millions of (wine) gallons flowing. I have since repeated the calculation of my notes with greater care, and find the quantity in standard gallons equal to 39,601,266—from that time to the date of the recent gauging, the river has been falling regularly,—but as it fell towards the last more slowly than at first, and that we may run no risk of *over* estimating, I give *twice* the value in averaging, to the *low* result, that I do to the *high one*, and upon this principle I find the daily discharge for the time mentioned (49 days) equal to 31,836,248 standard gallons.

One other remark—Our Croton reservoir will be 400 acres in extent, and will contain therefore, about 100,000,000 of gallons to each foot of depth at the surface. The disposition of the works at the head gate, will be such as to admit of drawing this *down* if necessary, say 3 1-2 feet (350,000,000) with a residue of *held still* sufficient for the full supply of the conduit—we shall thus have a disposable surplus, for occasions of drought, sufficient, after deducting an ample allowance for evaporation, to afford 5,600,000 gallons per diem for fifty years, and this being added to the preceding average for that time, gives an available aggregate of 37,436,948 gallons per diem.

All these calculations, it will be recollected, are founded upon actual ascertained results, during a season of unparalleled drought—on this point there is no difference of opinion. The counties of Westchester and Putnam, furnish incontestible proof of it, in the multitude of streams and springs every where noticed as having failed *this year*, which have never been known to fail before; and the Croton itself, according to the concurrent testimony of the inhabitants, has been at the same time *lower* and low for a longer period than is remembered on any former occasion. A result, therefore, obtained under these circumstances may de deemed certain, and should, I think, put the question of supply enterely at rest.

I should not omit to mention that I gauged the water on the same day at the wire *factory* below Garrittson's Mill, and found it to agree very nearly with the gauging *above*, the pond having been drawn down (evening) and the head gates drawn clear of the water,—the difference was only about about 200,000 gallons. This gauge, however, was less likely to be accurate than that at Pine's bridge, as there was a considerable stream wasting through the dam, which it was difficult to measure accurately, on account of its spreading among the stones. I shall continue to keep an eye upon this subject, should anything further occur worthy of notice.

I remain, yours very truly,
D. B. Douglass.
Chief Engineer N. Y. Water Works.

Stephen Allen, Esq. Chairman, &c.

* This quantity estimated in Ale gallons is 21,210,433.

And in common wine gallons, 26,266,904.